Exhibit A

Prepared for:
Royston Rayzor

Prepared by:
Dr. Cord Harris, Ph.D., P.E.
Dr. Lis Nelis, Ph.D.
Shaun Gannon
Ramboll US Consulting

Date:
July 9, 2021

Project Number:
194000886

EXPERT OPINION IN THE MATTER ENTITLED:

KIRBY INLAND MARINE, KIRBY INLAND MARINE, LP VS FPG SHIPHOLDING PANAMA 47 S.A., K LINE ENERGY SHIP MANAGEMENT, AND THE VLGC GENESIS RIVER SHIPHOLDING PANAMA 47 S.A., K LINE ENERGY SHIP MANAGEMENT, AND THE VLGC GENESIS RIVER

SIGNATURE

We certify that the information and opinions contained in this report are correct to a reasonable degree of scientific certainty.

Benjamin "Cord" Harris, PhD, PE

Lis Castillo Nelis, PhD

for

Shaun Gannon

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1. INTRODUCTION AND OVERVIEW OF OPINIONS

Ramboll US Consulting, Inc. (Ramboll) was retained by Royston, Rayzor in connection with their representation of two of the vessel defendants in the litigation referenced above. This report was authored by Dr. Cord Harris, a senior managing consultant at Ramboll, and Dr. Lis Nelis, a managing consultant at Ramboll, and modelling was overseen by Shaun Gannon. Information on their education and experience are provided in the following sections and copies of their curriculum vitae are included in Appendix 1 of this report.

1.1 Education and Professional Background for Dr. Harris

Dr. Harris is a professional engineer (Texas) at Ramboll. He received a Ph.D. in Civil Engineering from Texas A&M University in 2002 with a dissertation entitled "Biodegradation of polycyclic aromatic hydrocarbons and other petroleum compounds". He received a M.S. in Civil Engineering from Texas A&M University in 1997 with a thesis entitled "Nutrient Dynamics in Marsh Sediments Contaminated by an Oil Spill Following a Flood". He received a B.S. in Civil Engineering from Texas Tech University in 1994. His graduate work at Texas A&M was funded in part by grants from the Texas General Land Office to study methods to enhance oil spill recovery in Texas coastal habitats.

Dr. Harris has 19 years of experience in managing environmental issues associated with contaminant releases, site investigation, remedy selection, design and implementation and disposition of properties. He has managed sites in 10 different states under various state programs, the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and the Clean Water Act (CWA).

Dr. Harris' experience includes professional consulting services at numerous sites and facilities associated with various types of oil materials including crude oils, benzene, heating oil, diesel, gas condensate, motor oil, and various types of gasoline. His experience includes evaluating the potential for impacts to various receptors and developing remedial strategies to mitigate those impacts. He has evaluated monitored natural attenuation of petroleum hydrocarbons and designed and implemented remedies to enhance the bioremediation of petroleum hydrocarbons. Appendix 1 includes his current curriculum vitae. Ramboll is being paid $285 per hour for his services. He has not provided testimony in the past five years.

1.2 Education and Professional Background for Dr. Nelis

Dr. Nelis received a Ph.D. in Evolutionary Biology from the University of Chicago in 2008 with a dissertation on the effects of anthropogenic disturbance and invasive species on community dynamics titled "An investigation of synergistic interactions among invasive species." She also earned an M.S. in Evolutionary Biology from the University of Chicago in 2004. Dr. Nelis' graduate work was largely funded by the National Science Foundation to study the effects of invasive species on biological communities. After her Ph.D., Dr. Nelis won a competitive National Science Foundation fellowship to be a postdoctoral research fellow at Stanford, where she continued to study population dynamics and community interactions.

Dr. Nelis has 17 years of biodiversity, invasive species, environmental science and project management experience, with particular expertise in analysis of the effects of anthropogenic disturbances on ecosystems. She applies her expertise in remediation, environmental damage assessments, ecological risk assessments, lender due diligence, analysis for sensitive species, and restoration of natural systems. Lis has worked on disturbances from chemical and oil spills, invasive species, grazing, erosion, and climate change. She is experienced in planning studies for restoration, management, conservation, and monitoring. She is also accomplished at integrating field data into mathematical models to predict long-term ecosystem outcomes. She uses her extensive analytical and programming skills to characterize, analyze, and model large data sets to support her clients. Lis has worked in many areas of the United States and in several countries in Latin America. She has provided scientific and strategic consultation to government agencies on management plans for a national park. Appendix 1 includes her current curriculum vitae. Ramboll is being paid $225 per hour for his services. She has not provided testimony in the past five years.

1.3 Education and Professional Background for Mr. Gannon

Mr. Gannon is a professional engineer (New York, Ohio, Pennsylvania) at Ramboll. Mr. Gannon received a M.S. in Civil Engineering from Norwich University in 2007. He also earned an B.S. in Civil Engineering from the SUNY Institute of Technology in Utica, NY in 1997.

Mr. Gannon has extensive experience in hydrologic and hydraulic modeling in various situations. He is experienced with the numeric modeling of various water bodies, watershed hydrology and channel restoration using a wide variety of hydrologic and hydraulic computer models with GIS integration.

1.4 Tasks We Have Been Asked to Perform

We have been retained by Royston Rayzor on behalf of its clients, FPG Shipholding Panama 47 S.A., K Line Energy Ship Management, and the VLGC Genesis River, to provide expert opinions regarding the reformate released into the Houston Ship Channel on May 10, 2019 in the matter of Kirby Inland Marine, LP VS FPG Shipholding Panama 47 S.A., K Line Energy Ship Management, and the VLGC Genesis River. Opinions include rebuttal to the reports of Gabriel Johnson for Shrimp R US and Ivo Slabic, Dr. Paul Montagna, Mr. David Batker, and Mr. Ralph A. Litolff.

In preparing this report, we have reviewed the references cited in this report. Past research and professional experiences provide background information that we also considered in formulating this report. We reserve the right to amend, modify or supplement this report based upon receipt of new or additional information.

1.5 Overview of Opinions

Based on the analysis presented in this report, we have formed the following opinions:

1.6 Opinion 1

Given the volatile nature of reformate, the spilled reformate likely evaporated quickly from the surface of the water and the fraction that dissolved into the water column likely also attenuated quickly.

1.7 Opinion 2

The spill most likely impacted aquatic biota in a limited area for a few hours to a few days near the spill site and to the west based on the hydrodynamic modeling and attenuation of the free phase product. The limited nature of the impacts is also supported by the observation of only one fish kill of between 100 and 1000 fish, crabs, and shrimp during the spill response. Teams including state and federal representatives were out surveying the situation during the spill looking for impacts and only one location was identified.

1.8 Opinion 3

Given the limited impacts observed in proportion to the overall bay, it is unlikely that the spill had a significant impact on the shrimp, oyster, and fish populations in the system.

1.9 Opinion 4

The analyses from the water samples collected in the vicinity of the private oyster leases do not indicate that the reformate constituents impacted the oysters.

1.10 Opinion 5

The comparison of oyster lease production prior to and after Hurricane Harvey is not appropriate without significant sampling in a statistically valid manner to account for changes in the reefs and viable oyster habitat. Therefore, the conclusions by Mr. Johnson related to correlations of conditions pre- and post-Hurricane Harvey are not reliable or supported by sound science.

1.11 Opinion 6

The impacts from the spill were not likely to have long-term impacts due to the rapid attenuation of the reformate.

1.12 Opinion 7

Salinity was low for extended periods of time during 2019 due to large amounts of freshwater inflow to the bay. This is likely to have caused reductions in shrimp and oyster populations and their corresponding harvest. There was an extended period of salinity below 5 Practical Salinity Units (PSUs) in Galveston Bay near private oyster leases 390A, 391A, 392A and 432A in the second half of May 2019, unrelated to the spill, that is a likely cause of oyster mortalities.

2. BACKGROUND OF GALVESTON BAY AND SPILL EVENT

2.1 Galveston Bay

Galveston Bay is the largest bay in Texas covering about 600 square miles with a watershed of about 24,000 square miles including both Houston and Dallas/Fort Worth ("GALVESTON BAY REPORT CARD" 2020). This watershed area, in which half the population of Texas lives, contains storm water runoff and baseflows from the San Jacinto and Trinity Rivers as well as other bayous and creeks ("GALVESTON BAY REPORT CARD" 2020).

2.2 Port of Houston

The Port of Houston (Port) is one of the busiest ports in the world, ranking second among U.S. ports in terms of cargo tonnage, according to the United States Coast Guard (United States Coast Guard (USCG) 2018). In 2018, the average daily traffic in the Coast Guard Sector Houston–Galveston VTS area totaled about 629 vessel transits (including tankers, freighters, tows, and

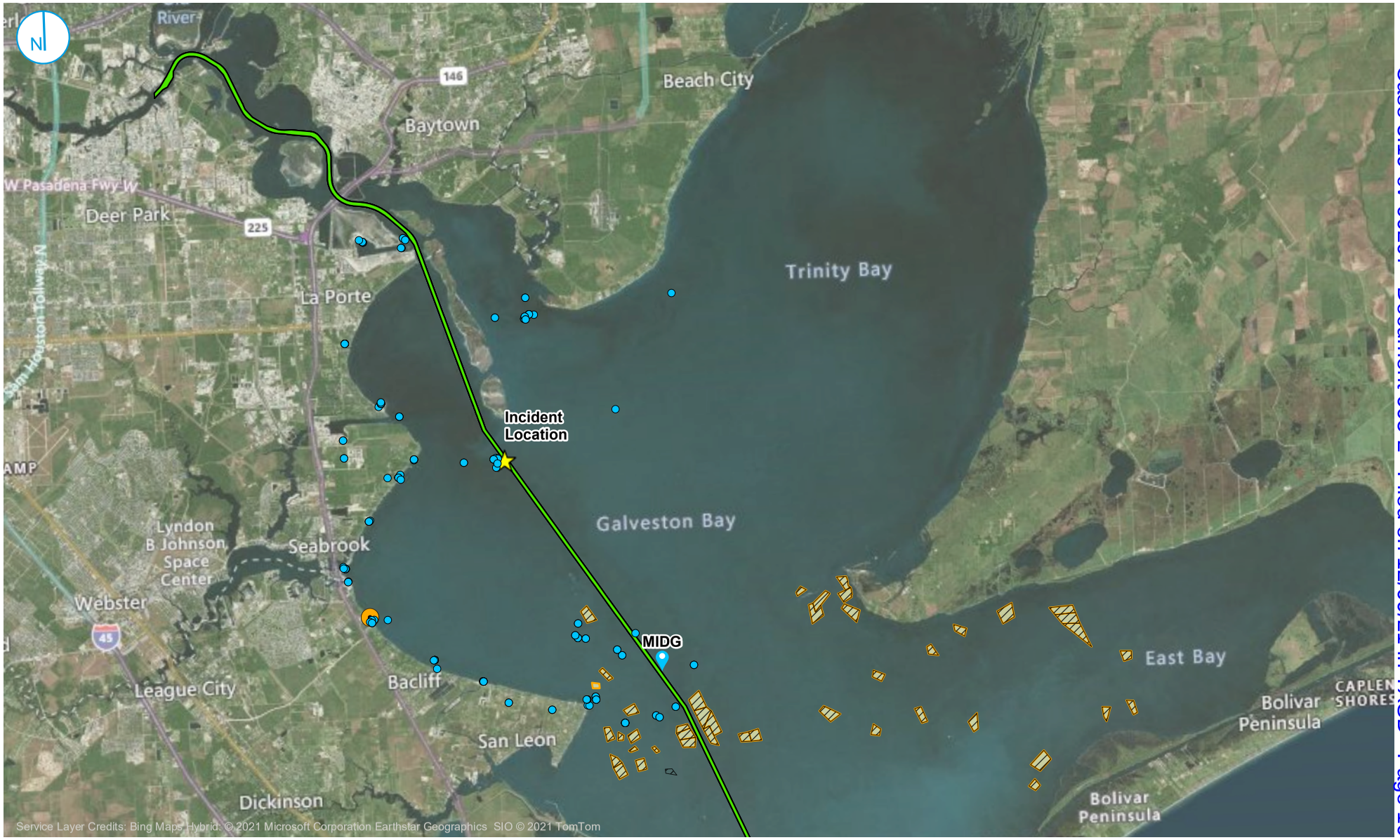
ferries, among others), with nearly 40 ships docked in port (United States Coast Guard (USCG) 2018).

2.3 Spill Event

On May 10, 2019, at 3:16 pm central daylight time (CDT)[1] the liquefied gas carrier *Genesis River* collided with a tank barge being pushed ahead by the towing vessel *Voyager* (National Transportation Safety Board, 2021). The collision occurred in the Five Mile Cut portion of the Houston Ship Channel south of the Bayport Flare (National Transportation Safety Board, 2021). Figure 1 shows the spill location, locations of private oyster leases in both 2018 and 2020, the location of an observed fish kill and the Texas Water Development Board water quality monitoring station at MIDG.

A spill of reformate occurred when the Genesis River's bow penetrated through the barge's double hull and breached its center cargo tanks releasing approximately 11,276 barrels (473,600 gallons) of reformate into the waterway (National Transportation Safety Board, 2021). Reformate is a high-octane blend stock for making gasoline that contains high levels of aromatics such as benzene, toluene, ethylbenzene and xylenes (Stout and Wang 2016).

[1] All times herein are reported as central daylight times, based on a 12-hour clock.



Incident Location
Sampling Location
MIDG
Fish Kill

Private Oyster Leases 2020
Private Oyster Leases 2018
Houston Ship Channel

0 9,900 19,800 Feet

Notes
1. Sampling locations on land were incorrectly captured, and should be in water at a desired location.

LOCATION OF SPILL IN RELATION TO PRIVATE OYSTER LEASES AND OTHER LANDMARKS

Bayport Collision
Galveston Bay, Texas

FIGURE 01

RAMBOLL US CONSULTING, INC.
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2.3.1 Spill Response

On May 10, 2019, at 3:41 pm, the incident command system was activated by the United States Coast Guard at Houston-Galveston headquarters (National Transportation Safety Board 2021). By 7:35 pm, oil spill containment booms were deployed around barges and additional booms were being installed across inlets and other sensitive marine areas around Galveston Bay (National Transportation Safety Board 2021). A total of seven oil skimmers were deployed to recover reformate/water mixture in the vicinity of the accident site (National Transportation Safety Board 2021). At 4:00 am on May 12, 2019, the US Coast Guard Captain of the Port opened the Houston Ship Channel for navigation to outbound traffic only (National Transportation Safety Board 2021).

2.3.2 Department of State Health Services (DSHS) Advisories

On May 12, 2019 at 5:59 PM, the Department of State Health Services (DSHS) issued a statement advising people not to fish or eat any seafood from the portions of Galveston and Trinity Bays north of a line from the end of the Texas City Dike to Smith Point (Galveston County Health District 2019). DSHS indicated that the spill was not affecting the entire area at that time (Galveston County Health District 2019). While public oyster harvesting was already closed, DSHS closed private oyster harvesting in this area as well for 16 days (Galveston County Health District 2019). This notice was kept in place until May 28, 2019 when the Department of State Health Services lifted the temporary warning to not eat seafood from portions of Galveston and Trinity Bays and private oyster harvesting was reopened in this area (Galveston County Health District 2019). The seafood warning and closure for private oyster harvesting was in place for 16 days.

2.3.3 Reformate Sample from May 10th Barge Collision Characteristics

Samples of the reformate liquid from the spill were sent to the Louisiana State University, Department of Environmental Sciences Response & Chemical Assessment Team, which performed several analyses on the material (LSU RCAT Team 2019). The analysis results indicated that the material contained mostly alkyl benzenes for C2 benzenes to the C4 benzenes with very small amounts of naphthalene and the C1 and C2 alkyl naphthalenes, but there was no benzene and a small amount of toluene detected (LSU RCAT Team 2019).

The LSU RCAT Team evaporated a portion of the sample of the reformate in the laboratory under a hood at room temperature for 4.3 hours and 65% of the material had evaporated (LSU RCAT Team 2019). After evaporation for 4.3 hours at 25°C (77°F) in a laboratory hood, results indicated that 65% of the material evaporates including most of the xylenes, ethylbenzene and a significant portion of the C3 benzene were lost to evaporation (LSU RCAT Team 2019). The temperature at E Meyer Rd Seabrook (KTXSEABR78) was reported to have a temperature low of 77°F and closer to 87°F at the time of the spill with wind of 7.4 miles per hour from the southeast observed that afternoon (Weather Underground 2019). This suggests that the reformate would evaporate quickly similar to that observed in the LSU RCAT laboratory evaluation.

2.4 Galveston Bay Fish and Shellfish Populations

Populations of fish and shellfish in Galveston Bay vary over time and are monitored to provide information for fishing and environmental quality by the Texas Parks and Wildlife Department (TPWD) and are reported in The State of the Bay (HARC (Ed.) 2020). The State of the Bay is "*sponsored by the Texas Commission on Environmental Quality's (TCEQ) Galveston Bay Estuary*

Program (GBEP) as a resource for historical context and up-to-date analysis of the conditions in and around Galveston Bay."

TPWD uses several methods to monitor the abundance of fish and shellfish communities: gill nets, bag seines, shrimp trawls, and oyster dredges (HARC (Ed.) 2020). Gill nets are used for larger fish and are deployed close to shore. Bag seines are used to collect small organisms in near shore areas, and trawls are used to collect benthic (bottom or near bottom) fish in the open bay. Oyster dredges are used to sample oysters. Sampled abundance data for each species is then converted to catch per unit effort (CPUE), which is a standard method to calibrate data so that they can be compared between different sampling events (HARC (Ed.) 2020).

Using these gear types, TPWD has sampled over 60 species of fish in addition to crabs, oysters, and other shellfish since the 1970s. Sampling years vary by species, but population dynamics can be viewed and data between the 1970s and 2017 can be downloaded on the State of the Bay webpage (HARC (Ed.) 2020). In addition, analyses of population trends are discussed. We incorporated a review of these data and analyses in our expert report.

2.4.1 Shrimp Populations

In Galveston Bay, populations of both brown and white shrimp vary over time as seen in Figures 2 and 3 reproduced from the State of the Bay (HARC (Ed.) 2020).

The temporal trends for brown and white shrimp are presented in this section based on analysis of the most recent TPWD data (HARC (Ed.) 2020). HARC (2020) uses a criterion of 0.25 for the coefficient of determination (r^2) to define whether a trend is increasing or decreasing (HARC (Ed.) 2020). Polynomial trend lines describing abundance in this section represent the trend over time, but they do not provide causal explanations of the trends (HARC (Ed.) 2020). Changes in abundance of the shrimp species could have many possible causes, such as changes in commercial and recreational fishing harvest, predation, disease, prey levels, or alterations to physical environment (HARC (Ed.) 2020). As can be seen in these figures, the CPUE for shrimp can vary by a factor of 5 year-to-year.

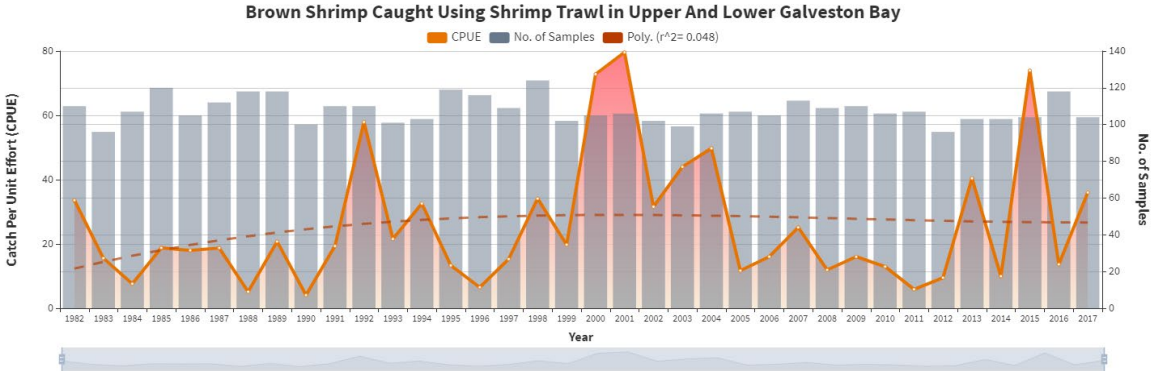

Figure 2: Brown Shrimp Caught Using Shrimp Trawl in Upper and Lower Galveston Bay over Time

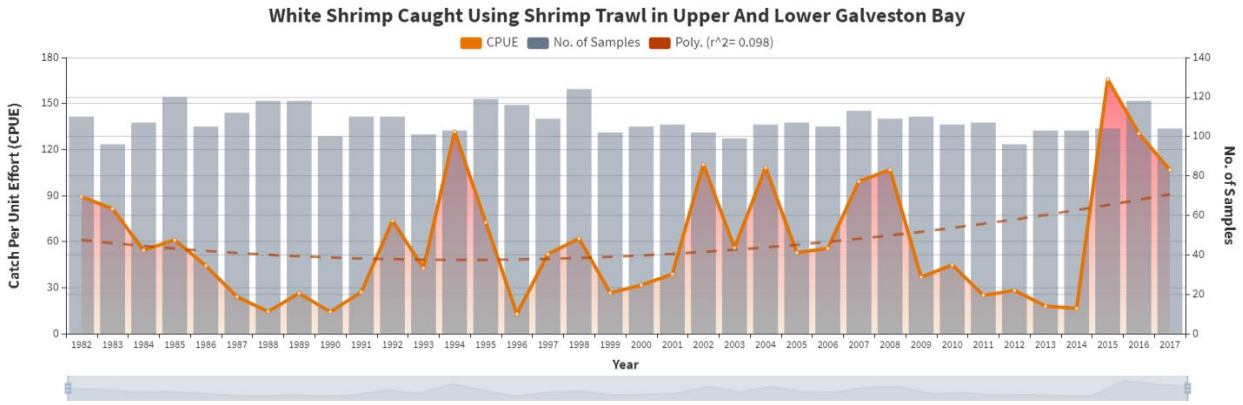

Figure 3: White Shrimp Caught Using Shrimp Trawl in Upper and Lower Galveston Bay over Time

The National Oceanographic and Atmospheric Administration (NOAA) utilizes more robust environmental models that take additional factors into consideration (Hart 2019). Both biological (monitoring inshore shrimp fisheries in Texas) and environmental factors are correlated to the fate of young shrimp entering the estuaries. Environmental variables that correlate well to shrimp production include air temperature (greater than 68°F), salinity, and tidal height (Hart 2019). The Galveston Bay Bait Index derived from annual monitoring of the Galveston Bay bait shrimp fishery during late April through mid-June has consistently been the most reliable estimate of subsequent brown shrimp production off the Texas coast for more than five decades (Hart 2019). Using the Galveston Bay Bait Index model, NOAA predicted that the 2019 brown shrimp season would be approximately 20% lower or 4.8 million pounds below the average catch of 24.8 million pounds caught off the Texas Coast between 1981-2017 (Hart 2019). Additionally, the NOAA study found that extremely low salinities in Galveston Bay for May and June of 2019, were "unfavorable for continued recruitment and stock growth." Therefore, lower shrimp catches during 2019 are likely attributable to the influx of freshwater from major rivers and tributaries that remained at or above flood stage that led to low salinity and slow growth as predicted by NOAA.

2.4.2 Oyster Populations

Oyster populations from 1986 through 2017 as evaluated using CPUE varying annually are shown as Figure 4 reproduced from The State of the Bay c. While there is CPUE variation for year to year, there has been an overall downward trend in oyster CPUE since the early 1990s. The polynomial function used to model the oyster population had a relatively high coefficient of determination at r^2=0.575 showing a decline (HARC (Ed.) 2020). As reported in the State of the Bay, one of the most important of these stressors in Galveston Bay is infection by "dermo" (Perkinsus marinus), a protozoan parasite that thrives in warm waters of relatively high salinity (Culbertson, J., Anderson, J. B., Karel, W., Hensley, R., Robinson, L., & Ray 2016). A range of 10 to 50% mortality of market oysters in Galveston Bay result from this parasite annually (HARC (Ed.) 2020). The quantity and timing of freshwater inflows is significant because salinity directly affects mortality due to predators, and mortality or morbidity due to parasitic infection (HARC (Ed.) 2020). Sediment deposits associated with Hurricane Ike covered about 60% of the oyster reefs in Galveston Bay with sediment (HARC (Ed.) 2020). Oyster reefs habitat in Galveston Bay was further negatively impacted by increased fishing pressure resulting from the Deepwater Horizon accident in 2010 that closed oyster reefs in the Eastern Gulf of Mexico (HARC (Ed.) 2020).

Another important factor associated with oyster populations is the occurrence of hurricanes. A discussion of the effects related to the most recent major hurricane, Hurricane Harvey, are discussed in the following section.

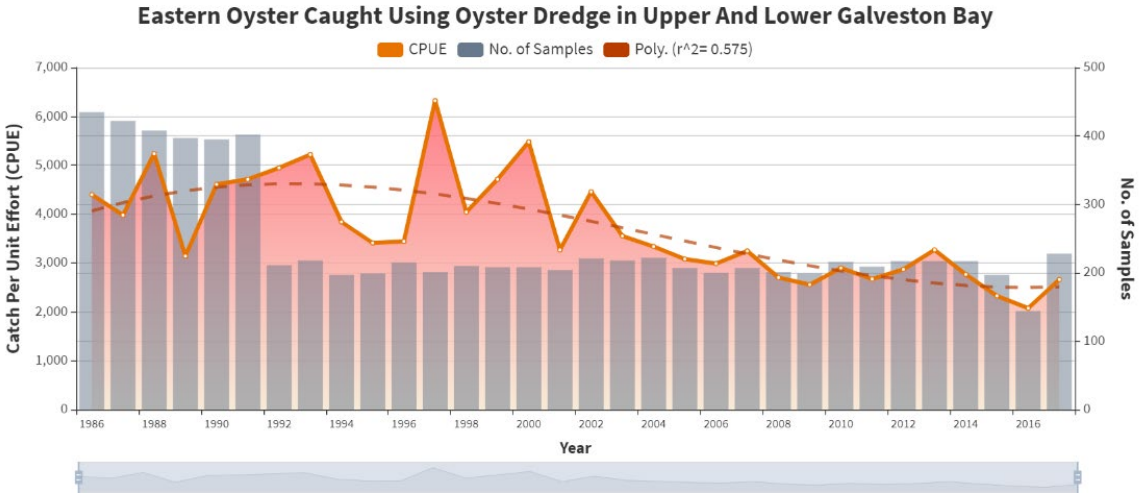

Figure 4: Eastern Oyster Caught Using Oyster Dredge in Upper and Lower Galveston Bay over Time

2.4.3 Finfish

Fish can detect chemical contaminants and move away. In Tierney's (2016) review article, he found that "most natural hydrocarbons are avoided" by fish (Tierney 2016). In Araújo et al.'s (2016) review article, the authors found that aquatic organisms could avoid areas assiduously enough to cause local extinction (Araújo, Moreira-Santos, and Ribeiro 2016).

Even if finfish had not avoided the area of the spill, it is difficult to accurately predict future catch rates, although population trends can often be modeled. Like shrimp and oysters, finfish populations vary over time due to many factors such as climate and fishing pressure (HARC (Ed.) 2020). Based on the review of State of the Bay and several Galveston bay recreational fishing websites, the following species of finfish are of special interest for commercial or recreational fishing: red drum or redfish (*Sciaenops ocellatus*), speckled trout or spotted seatrout (*Cynoscion nebulosus*), southern flounder *(Paralichthys lethostigma*), and gulf menhaden (*Brevoortia patronus*)(FishingBooker 2021; FishAnyWhere.com 2021). The population dynamics of these species in Galveston Bay are described below.

According to the State of the Bay, in 2017, populations of finfish were declining in Upper and Lower Galveston Bay when sampled by gill net (HARC (Ed.) 2020). The red drum population was decreasing after a high in 2011 (r^2=0.291) and populations varied up to 5-fold between years (HARC (Ed.) 2020). Spotted seatrout also had a population that was decreasing after a high in 2014 (r^2=0.644), and variation within years varied up to twofold (HARC (Ed.) 2020). Southern flounder were steeply decreasing after a high in the late 1990s (r^2=0.382); in fact, in 2017 no southern flounder were caught in 12 samples (HARC (Ed.) 2020). Gulf menhaden had decreasing populations as well (r^2=0.248), with very few individuals caught in 2016 and 2017 and up to twofold changes in CPUE between years in the 2010s (HARC (Ed.) 2020). All these species had real downward trends, according to the 0.25 r^2 standard used by the State of the Bay, except for

gulf menhaden. The dates of the 2017 sampling were not listed, but in none of these cases was the 2017 sample an obvious outlier caused by Hurricane Harvey. Instead, the downward population trends generally appeared over multiple years.

The plaintiff's reports that allege damage to the fishing industry do not take fish avoidance or modeled population trends into account when assessing damages. Instead, the plaintiff's reports ascribe all losses to the spill making the reports unreliable.

2.5 Hurricane Harvey Impacts on Galveston Bay

In 2017, Hurricane Harvey, the wettest tropical cyclone in the U.S. history, had dramatic impacts on Galveston Bay (Du et al. 2021). The total freshwater load into Galveston Bay during Harvey and the following month was 11.1×10^9 m^3, which is equivalent to approximately 3 times the entire volume of Galveston Bay (3.81×10^9 m^3)(Du et al. 2019). Galveston Bay receives annual mean river discharge of 350 m^3 s^{-1} (or yearly load of 1.1×10^{10} m^3, about 3 times the total bay volume) (Du et al. 2019). Therefore, Hurricane Harvey produced runoff approximately equivalent to an entire year's worth of mean river discharge volume, thereby resulting in a period of extended low salinity.

2.5.1 Harvey Impacts on Oysters

Hurricane Harvey caused a major oyster kill event in Galveston Bay due to prolonged low salinity conditions caused by freshwater inflow (Du et al. 2021). Texas Parks & Wildlife Department measured oyster mortality at 130 sampling sites, covering most of the harvestable public oyster reefs in Galveston Bay on October 2 and 11, 2017, about one month after Harvey made landfall (Du et al. 2021). Oyster measurements at 130 sites in Galveston Bay showed that the mean oyster mortality drastically increased from 11% before Harvey to 48% after Harvey as seen in Figure 5 reproduced from Du et al. (Du et al. 2021). Post-Harvey oyster mortality exhibited large spatial variability and was up to 100% at some major reef complexes (Du et al. 2021). A salinity of 5 Practical Salinity Units (PSU) was suggested as a critical threshold value for oyster recruitment, survival, and growth, although the threshold value varies with water temperature (Du et al. 2021). Salinity levels in the vicinity of private oyster leases were below 5 PSU for an extended period of time during May 2019. Figure 5 reproduced from Du et al. also shows a trend line with an r^2 of 0.51 that correlates the period of low salinity below 5 PSU to oyster mortality (Du et al. 2021).

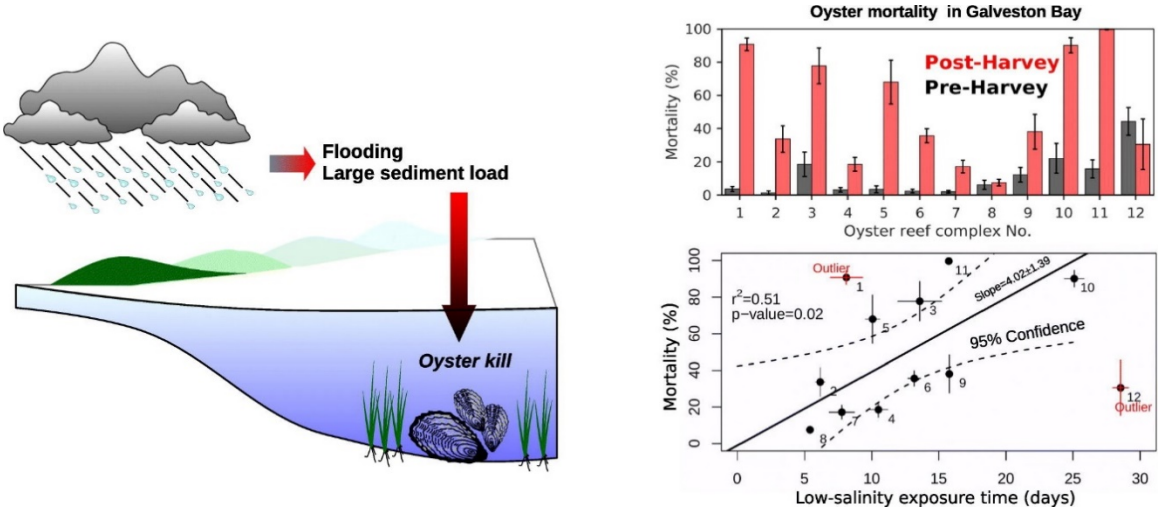

Figure 5: Graphical Abstract adapted from (Du et al. 2021), Copyright 2021 Elsevier B.V.

Another factor associated with flood events is the increased deposition of sediments that can smother oysters (Du et al. 2021). The total volume of the flood layer associated with Hurricane Harvey was found to be $1.24X10^8$ m^3, with an average thickness of 10.5 cm of sediment deposited across Galveston Bay(Du et al. 2019). This flood deposit was equivalent to 18 years of average annual sediment load to the bay (Du et al. 2019). The mortality values observed in the 2017 TWPD sampling did not correlate well with sediment deposition (Du et al. 2021). However, this sediment influx could have longer lasting effects not observable in the few months following their deposition. Sediment deposition was identified as a major factor following Hurricane Ike. For all the oyster sampling sites, brown shells were dominant, while black shells indicating mud burial were rare (Du et al. 2021). Du et al. attributed this brown color to low salinity mortality.

Table 1 shows seventeen other major oyster kill events attributable to floods, low dissolved oxygen, dinoflagellate blooms, heat waves, increased seawater temperature by ~1.5°C, high nutrient loads, and low salinity levels have been observed throughout the world over the years, (Du et al. 2021). Despite their prevalence, these known causes of oyster kill events were not evaluated in the Plaintiffs' expert reports, making their conclusions unreliable.

Table 1: Major Oyster Kill Events (Du et al. 2021) , Copyright 2021 Elsevier B.V.

A list of reported major oyster kill events.

Location	Time	Description	References
Moreton Bay, Australia	Late 19th century	Declined oyster reefs after major flood events in the late 19th century.	Diggles (2013)
Matsushima Bay, Japan	1958	Severe moralities were reported following the 1958 El Nino.	Imai et al. (1965)
Apalachiocola Bay, US	1960–1984	Oyster landing was low in years when flows exceeded 30,000 cfs for 100 days or more.	Wilber (1992)
Northern Gulf of Mexico, US	1950–2003	Oyster harvests in five major estuaries were inversely related to freshwater inflow. Most of the lows in landing (17 of 19) coincided with peaks in discharge of major rivers feeding their estuaries. Opening of Bonnet Carré spillway lowered oyster landing in Mississippi.	Turner (2006)
Puget Sound, US	1998	Oyster mortality was high in the late summer when dissolved oxygen was low.	Cheney et al. (2000)
Morlaix Bay, France	1999	The mortality was associated with *Vibrio* strain, whose effect was more serious under higher temperature.	Lacoste et al. (2001)
Wonboyn Lake, Australia	2002	An unprecedented mortality (15–100%) of Sydney rock oyster in aquaculture zones was associated with severe inflammation, which was possibly caused by bloom of dinoflagellate.	Ogburn et al. (2007)
Tomales Bay, US	2003	High levels of mortality were observed and related to the presence of *Ostreid herpesirus*, whose impact appeared to be stronger when temperature was higher.	Burge et al. (2006)
Bannow Bay and Dungarvan Harbour, Ireland	2003	Mass mortality event (>20%) of oyster occurred and was associated with high temperature and high nutrient.	Malham et al. (2009)
Mission–Aransas Estuary, US	2007	Flood event caused reduction of oyster abundance. Oyster population recovered within 1 year.	Pollack et al. (2011)
Thau lagoon, France	2008	A major oyster mortality event coincided with a nationwide increase of ~1.5 °C in winter seawater temperature.	Pernet et al. (2010)
Breton Sound, Louisiana, US	2010	Management responses to Deepwater Horizon oil spill caused an extended low-salinity (<5 PSU) in hot summer months, which led to a high mortality and low recruitment of oyster.	La Peyre et al. (2013)
Delaware Bay, US	2011	Two storm events (Hurricane Irene and Tropical Storm Lee) generated extreme flooding in Delaware River and caused prolonged baywide low salinity. Monthly mortality was up to 55%.	Munroe et al. (2013)
Sanfrancisco Bay, US	2011	A series of atmospheric river made landfall within California, driving an extreme freshwater discharge and leading to nearly 100% of oyster mortality at the northern bay.	Cheng et al. (2016)
Port Stephens, Australia	2013–2014	Spatial variations in oyster microbiome were characterized by the relative abundance of pathogenic bacteria.	King et al. (2019)
Tasmania, Australia	2016	*Ostreid herpesvirus*-derived mortality linked with the long and intense marine heat wave.	de Kantzow et al. (2017)
Mississippi Sound, US	2019	The mortality event was caused by opening of Bonnet Carré Spillway to release pressure from high discharge of Mississippi River on New Orleans.	Gledhill et al. (2020)

2.6 Salinity Levels during May 2019

The Texas Water Development Board (TWDB) has continuously monitored estuarine salinity and water quality since 1986 to determine the effects of and needs for freshwater inflows to the state's bays and estuaries (Texas Water Development Board 2019). Data from TWDB monitoring station MIDG is presented below (Latitude: 29.508, Longitude: -94.875) (Texas Water Development Board 2019). The location is described as Mid Galveston Bay near Red54 @range marker in the Trinity-San Jacinto Estuary and Galveston Bay (Texas Water Development Board 2019).

Figure 6 shows salinity levels measured in unit of PSU. Note that salinities drop below 5 PSU starting on May 11, 2019. Then between May 17th and June 1st, the salinity was generally below 5 PSU for 15 days.

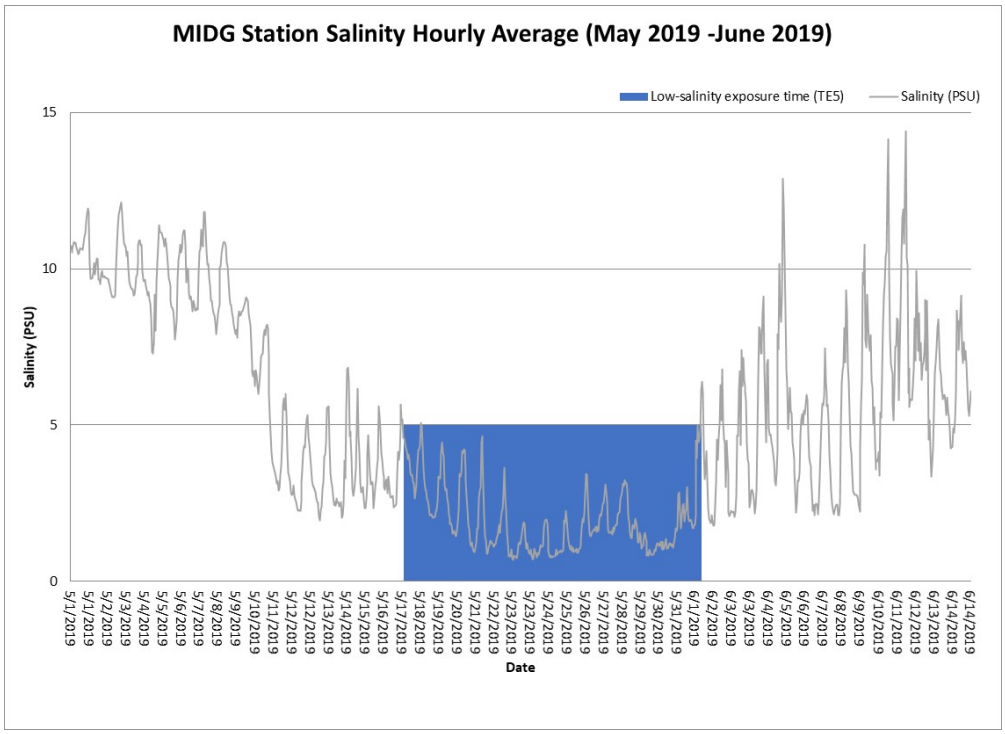

Figure 6: MIDG Station Salinity Levels over Time (data from (Texas Water Development Board 2019))

Calculating the expected mortality because of an extended period of low salinity for the period of May 17, 2019 through June 1, 2019 (15 days) using the Du et al. 2021 report trend line (slope 4.02±1.39), the range of expected oyster mortalities with a 95% confidence interval would be 39.45% to 81.15% with a mean of 60.3%.

3. REFORMATE FATE AND TRANSPORT

3.1 Overview

Following a reformate spill in surface water, two fates are most likely: evaporation to the atmosphere and biodegradation (Prince, Parkerton, and Lee 2007). Factors involved in the maximum evaporation to the atmosphere include the initial direct evaporation to the atmosphere for the reformate material on the surface of the water and the subsequent volatilization from the water surface after the compounds dissolved into the water column. A maximum evaporation rate of 84% was reported for gasoline over a 48 hour period (Pimsee et al. 2014). Therefore, it is expected that evaporation and volatilization to the atmosphere are the primary mechanisms for loss from the reformate spill. Also, the time required for maximum solubility for a PAHs from gasoline was less than an hour (Pimsee et al. 2014). This means the dissolved phase concentrations likely peak within the first hour and then decline rapidly as observed in the studies involving gasoline reported by Pimsee et al. (2014). Studies have evaluated the aerobic biodegradation of unleaded, unoxygenated, regular gasoline by inocula from seawater and other water sources and observed rapid biodegradation with an overall median "half-life" of 5 days for biodegradation (Prince, Parkerton, and Lee 2007). This information is important in understanding

the fate of the reformate as well as the dissolved phase plume after a portion of the material dissolves into the water phase.

3.2 Modeling Approach and Software

The modelling was performed by a Ramboll Modelling Team consisting of Ahintha H. Kandamby Ph.D. and Shaun Gannon. The Ramboll Modelling Team used the best available public data and numerical modeling were used to study the fate of the free-phase reformate in coastal waters. In this study, environmental data and chemical property information were input into a 3-D coastal hydrodynamic model to investigate the time, concentrate, and free-phase plume size and distance of the reformate that spilled into Galveston Bay as a result of the collision on May 10th.

3.2.1 Data

The environmental input data used in the numerical modeling was the following:

- **Bathymetric data:** coastal digital elevation model (DEM) from the National Oceanic and Atmospheric Administration (NOAA) for Galveston Bay. The resolution is 1/9 arc second (10 meters/90 feet) and covers the entire bay. The data was projected from its native World Geodetic System 1984 (WGS84) coordinate system to North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM) Zone 15N.
- **Wind data:** current and historical meteorological observations from NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) Tides & Currents dataset at 4 gaging stations around the bay:
    - Morgan's Point, Barbour's Cut, TX (Station ID 8770613)
    - Eagle Point, Galveston Bay, TX (Station ID 8771013)
    - Galveston Railroad Bridge, TX (Station ID 8771486)
    - Rollover Pass, TX (Station ID 8770971)
- **Tidal Water Level data:** current and historical tides and coastal water level data from NOAA's CO-OPS Tides & Currents dataset for 4 gaging stations around the bay:
    - Manchester, TX (Station ID 8770777)
    - Galveston Bay Entrance, North Jetty, TX (Station ID 8771341)
    - Rollover Pass, TX (Station ID 8770971)
    - Galveston Railroad Bridge, TX (Station ID 8771486)

3.2.2 Numerical Modeling

The numerical model used in this study was the EE Modeling System (EEMS) Environmental Fluid Dynamics Code (EFDC+) software (version 10.2.0) developed by DSI, Inc., which is a state-of-the-art, multifunctional surface water modeling engine that includes hydrodynamic, sediment-contaminant, and eutrophication components designed to simulate aquatic systems in 1-, 2-, and 3-dimensions. The software contains a 3-D coastal hydrodynamic module, Lagrangian Particle Tracking (LPT) method to simulate larger scale spill events in oceans and bay areas. In this scenario, the motion of the particles (free-phase reformate) was primarily due to turbulence from bay currents generated due to wind drag and tidal hydrodynamics. In addition, the EFDC+ software allows for users to use widely accepted "Random Walk" method to generate the advection components due to the ocean hydrodynamics to simulate the Lagrangian Particle Movements in 3-dimensions, to better assess the behavior and movement of the particles. The programs terminology refers to oil spills and requires the input of oil parameter data, which it

uses to simulate the movement of oil particles. For this study, the terms "oil" and "reformate" will be used interchangeably in referring to the free-phase material.

The initial and boundary conditions of the EFDC+ model were:

- **Model Duration:** 5 days starting May 10, 2021 at time 12:00 am to May 15, 2021 at time 12:00 am
- **Oil Properties:** 770 kg/m^3 oil density, 1792.6 m^3 total volume of oil, 0.125 1/day biodegradation rate (first order) (Suarez and Rifai 1999), 22 ^oC oil temperature, 19,305 Pa vapor pressure at 925 °F (D. Henderson; S.B. Cole 1994), and 0.02 m^3/mol volume of a drifter at standard temperature and pressure. The vapor pressure was adjusted to 27.13 Pa at the ambient temperature of 22 ^oC using the regression equation: log(P/kPa) = 6.02994 - 1211.033/[(T/K)-52.36] (Shiu, W.-Y. 2000).
- **Reformate Spill Release:** instantaneous spill release allowing total volume of reformate to be available for the model duration
- **Boundary Conditions:**
    - Upstream**:** water level at the Manchester, TX gaging station
    - Downstream in the southern Galveston Bay Area**:**
        - South: open boundary tidal water level at the Galveston Bay Entrance Channel gaging station
        - South-East: open boundary tidal water level at the Rollover Pass, TX gaging station
        - South-West: open boundary tidal water level at the Galveston Railroad Bridge, TX gaging station

The upstream and downstream tidal boundaries were chosen to be sufficiently far away from the spill location to minimize the direct influence from the hydrodynamic boundary conditions and allowed the model to compute the hydrodynamics taking the wind and tidal conditions into account.

The vertical datum for all the tidal gage station readings for water levels and bathymetry were referenced to the Mean Lower-Low Water (MLLW) vertical datum in meters and the horizontal projection was in UTM Zone 15 coordinate system. The initial water level for the numerical model was derived from interpolating the water level readings at midnight on May 10, 2019, at the above mentioned four tidal gage stations.

The distribution of the initial spill was assumed to be 300 m by 300 m shortly after the initial release.

The hydrodynamic calibration for the water levels was performed using two gaging stations within the modeling domain at (1) Morgan's Point, Barbour's Cut, TX gaging station and (2) Eagle Point Galveston, TX gaging station.

The assessment of the numerical modeling results was conducted visually by compiling a series of 2- and 3-dimensional time-stepped maps to characterize the size, shape, and distance traveled of the simulated oil plume.

3.2.3 Modeling Results

The simulation results show the spill traveled in a north / north-west direction as it depicted in volume and thickness figures. The simulations did not result in any indication the free-phase reformate arrived at any shoreline on the western side of Galveston Bay as shown in the previous figures. In addition, the simulation did not show the slick passing over any non-restricted oyster harvesting areas. Figure 7 and 8 display the initial free-phase reformate distribution area and the total volume of spill randomly distributed over the spill area.

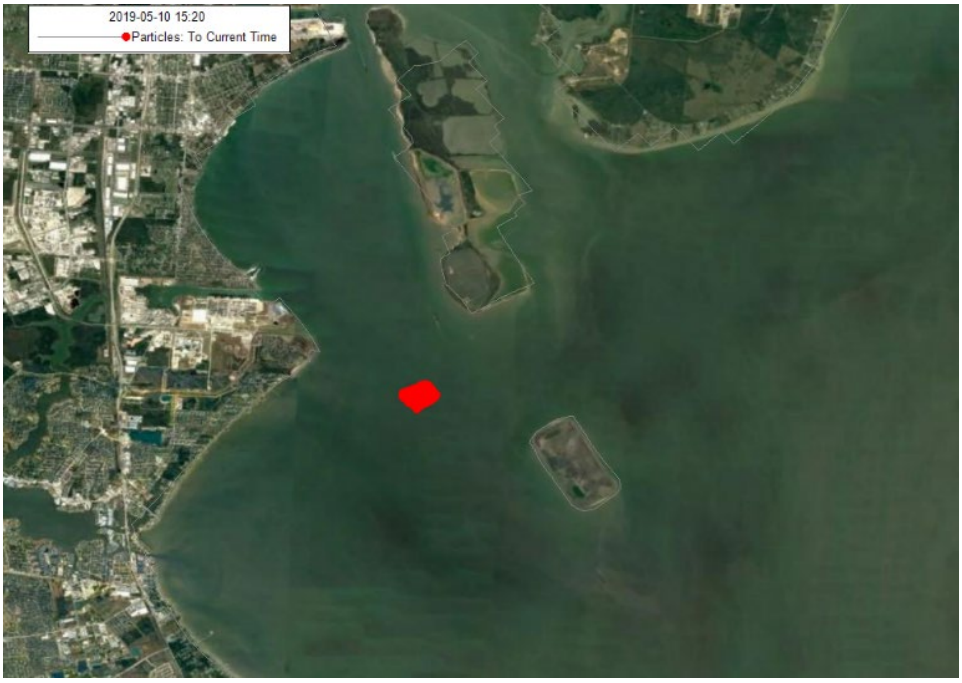

Figure 7: Spill Release at 3:20 pm on May 10, 2019

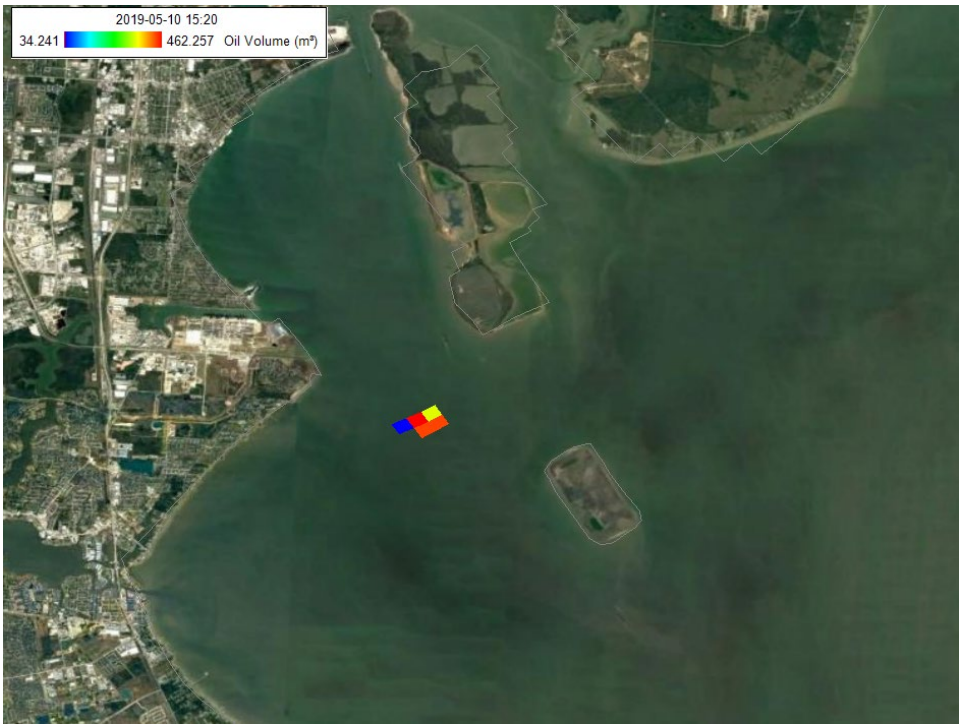

Figure 8: Total Free-Phase Reformate Volume at 3:20 pm on May 10, 2019

The free-phase reformate volume colors at the spill site in Figure 10 indicate the total volume inside each computational grid cell. This is an indication of oil distribution over an area. The reformate volume legend shows the maximum oil volume included in a grid cell (462 m^3). Figure 9 shows the location of the reformate after 6 hours of the release and its travel path in grey color. Figure 10 shows the reformate volume distribution over the spilled area. After 6 hours the simulation shows the maximum oil volume contained in any of the computational grid is about 6.8 m^3. This is approximately a 99% reduction in the free-phase reformate volume since the time of the spill.

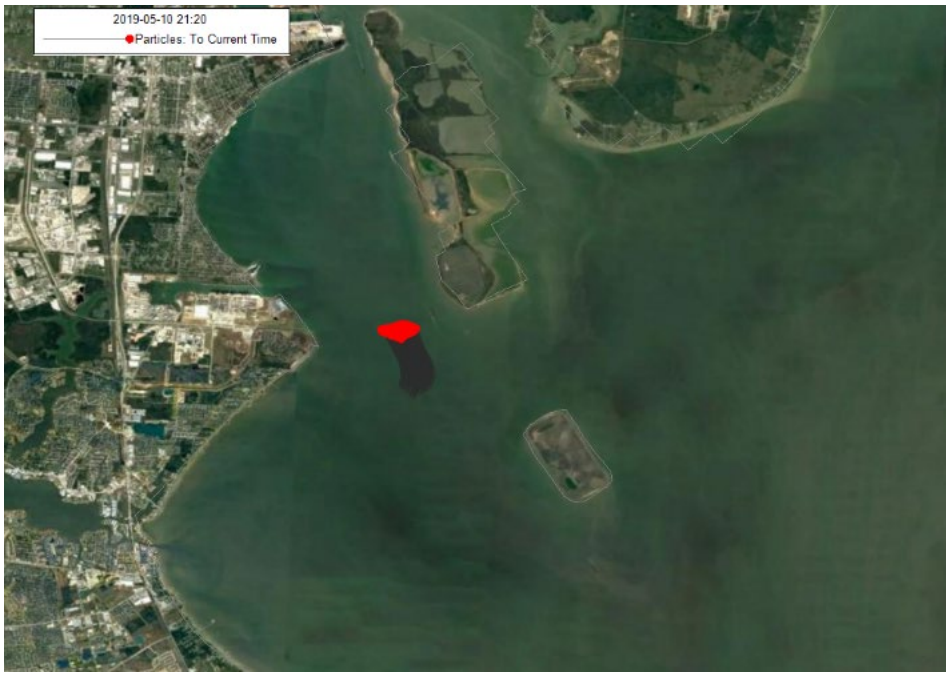

Figure 9: Free-Phase Reformate Location after 6 hours of release.

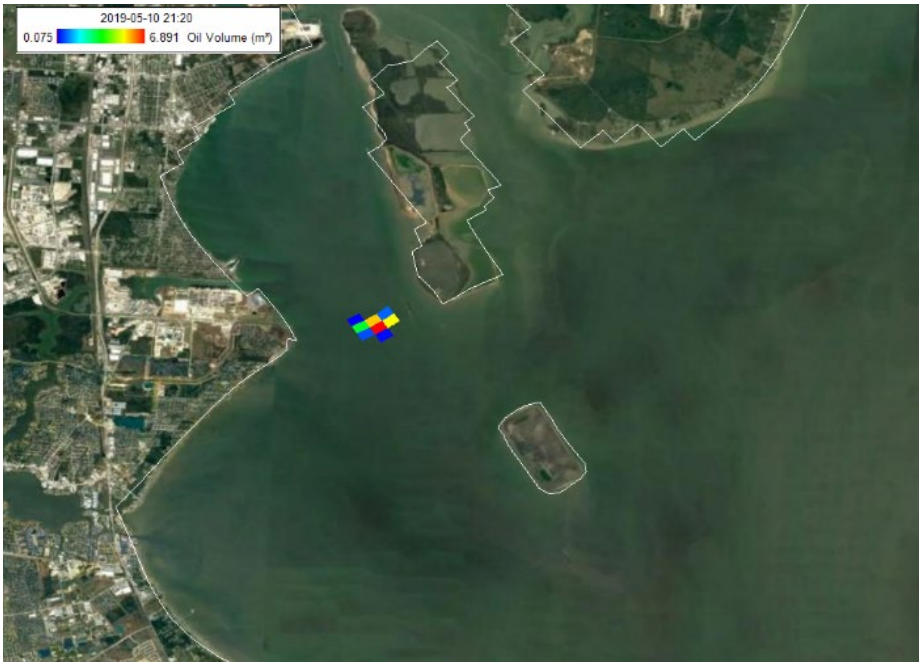

Figure 10: Total Free-Phase Reformate Volume after 6 hours of release

The water level calibration at the Eagle Point and Morgan's Point gage stations showed the simulated hydrodynamic tidal water levels are in phase and aligned with the amplitude of the observed gage station data satisfactorily. Therefore, the spill transport due to the tidal

hydrodynamics and observed wind effects accurately demonstrated the spill movement. However, waves generated in the spill site due to small boat and vessel traffic, the skimming activity, and waves generated due to helicopter flybys in the vicinity of incident site are not taken into the simulations. Such activity would further disperse the spill, therefore, simulated results are conservative and would have demonstrated a more rapid attenuation due to these other factors

3.2.4 Modeling Summary

The simulation indicated that the reformate material rapidly evaporates and moves in a direction to the north and northwest. The model indicated no significant impact from the free-phase reformate to the Galveston Bay shoreline or any of the private or public oyster populations outside of the restricted zone in the vicinity of spill as established by the Texas Department of State Health Services (Texas Department of State Health Services 2020). The observed free-phase product that impacted the shoreline is attributable to variability in the model and uncertainty in actual conditions. The potential impact to aquatic life within the travel path of the slick or the associated dissolved phase plume in the water will be discussed in the next section.

4. POTENTIAL IMPACTS TO AQUATIC LIFE

Samples of the reformate material, surface water and subsurface water were collected as part of the response to evaluate impacts in support of incident command and regulator decision-making processes. As part of the spill response, 137 water samples were collected and analyzed including both surface water and subsurface water (generally 10 ft below water surface (bws)) and duplicates (Table 2). These samples were to be collected in accordance with sampling plans approved by the Incident Commander, Federal On-Scene Coordinator (FOSC) and State On-Scene Coordinator (SOSC)(Cardno 2019). Laboratory analyses to be run in accordance with the environmental sampling plan included the following (Cardno 2019):

Source Reformate and Surface Samples Reformate Samples

- EPA Method 8260B/C for BTEX
- Modified EPA 8270D(GC/MS-SIM) for PAH (parent + alkylated homologues)
- EPA Method 8015 Modified GC-FID for TPH (including fractions)
- Modified EPA Method 8270D (GC/MS-SIM) for Petroleum Biomarkers
- ASTM D2622 for Sulfur content

Water Samples

- EPA Method 8260 for VOCs

Modified EPA 8270D(GC/MS-SIM) for PAH (parent + alkylated homologues)

Table 2: Number of Samples Collected by Date and Depth (may include duplicates)

Sample Date	Number of Surface Samples (WT) Collected	Number of Subsurface Samples (SS) Collected	Grand Total
5/12/2019	15		15
5/13/2019	13		13
5/14/2019	18	7	25
5/15/2019	18	5	23
5/16/2019	16	6	22
5/17/2019	16	6	22
5/19/2019	12	2	14
5/31/2019	1		1
6/3/2019	2		2
Grand Total	**111**	**26**	**137**

The resulting sample concentrations provided by Cardno were compared to acute aquatic benchmarks (Texas Commission on Environmental Quality (TCEQ) 2019) and exceedances for Ethyl Benzene, n-Propylbenzene, 1,3,5-Trimethylbenzene, m,p-xylene, Naphthalene, and 1,2,4-Trimethylbenzene are presented in Table 3. All exceedances are in the immediate vicinity of the barges and the samples on May 13, 2019 were collected beneath the product. Note that while these concentrations exceed acute aquatic concentrations many of them are less than 10 times over immediately below the reformate on May 13, 2019. No elevated concentrations were observed toward the south in the vicinity of the private oyster leases or oyster reefs outside of the restricted area as defined by Texas Department of State Health Services (Texas Department of State Health Services 2020).

Table 3: Samples with Exceedances of Acute Aquatic Benchmarks

SAMPLE_NAME	Date	Location	Analyte	Result (mg/L)	Benchmark (mg/L)	Aquatic Benchmark
WT-20190512-BARGE-001-T2	12 May 2019	Barge	m,p-xylene	0.095	0.032[2]	SW_Acute
WT-20190513-BARGE-001-T1	13 May 2019	Barge	1,2,4-Trimethylbenzene	7.08	1.305	SW_Acute
WT-20190513-BARGE-001-T1	13 May 2019	Barge	1,3,5-Trimethylbenzene	1.8	0.425[2]	SW_Acute
WT-20190513-BARGE-001-T1	13 May 2019	Barge	Ethyl Benzene	5.49	1.56	SW_Acute
WT-20190513-BARGE-001-T1	13 May 2019	Barge	Naphthalene	47	0.75	SW_Acute
WT-20190513-BARGE-001-T1	13 May 2019	Barge	n-Propylbenzene	1.1	0.385[2]	SW_Acute

According to the NTSB, reports indicated that a fish kill impacting between 100 and 1,000 fish, shrimp and crabs occurred on a limited stretch of shoreline, along with other wildlife impacts (National Transportation Safety Board 2021). During the spill response period on May 12, 2019, a fish kill was reported by Heather Biggs, Natural Resource Specialist for Texas Parks and Wildlife Department, on a limited stretch of beach on and near Galveston Bay Foundation property at 1725 Highway 146, Kemah, TX 77565(Biggs 2019)(KIM020954, KIM020955). Figure 11 shows the location of the fish kill that may be related to the reformate spill and the sample locations and concentrations that exceed acute aquatic benchmarks.

[2] The freshwater acute standard was used since there was not a saltwater acute standard.

WT-BARGE-001-T2	Acute Aquatic Benchmark	5/12/2019
m,p-xylene	0.032	0.095

WT-BARGE-001-T1	Acute Aquatic Benchmark	5/13/2019
1, 2, 4-Trimethylbenzene	1.305	7.08
1, 3, 5-Tremethylbenzene	0.425	1.8
Ethyl Benzene	1.56	5.49
Napthalene	0.75	47
n-Propylbenzene	0.385	1.1

Incident Location
Chemical Exceedance
No Chemical Exceedance
Fish Kill

Private Oyster Leases 2020
Private Oyster Leases 2018
MIDG

0 5,750 11,500 Feet

Notes
1. *The analytical method SW8270C was used to analyze Naphthalene.
2. Concentrations are reported in milligrams per liter (mg/L)
3. Sampling results are compared to acute aquatic benchmarks
4. Sampling locations on land were incorrectly captured, and should be in water at a desired location

SAMPLES WITH EXCEEDANCES OF ACUTE AQUATIC BENCHMARKS - TEXAS COMMISSION ON ENVIRONMENTAL QUALITY (TEC) 2019

Bayport Collision
Galveston Bay, Texas

FIGURE 11

RAMBOLL US CONSULTING, INC.
A RAMBOLL COMPANY

RAMBOLL

5. REBUTTAL TO PLAINTIFF'S REPORTS

In this section, we will review and provide rebuttal to the pertinent information or conclusions in the following expert reports submitted on behalf of the plaintiffs.

1. Mr. Gabriel Johnson (MREC Environmental, LLC), Report on Damages to Oyster Resources in Texas Private Leases 390A, 391A, 392A & 432A Due to Chemical Spill on May 10, 2019, Shrimp R US, May 2021.
2. Mr. Gabriel Johnson (MREC Environmental, LLC), Report on Damages to Oyster Resources in Texas Private Leases 430A Due to Chemical Spill on May 10, 2019, Ivo Slabic, May 2021.
3. Dr. Paul Montagna, Report on Claimant's Expert, Dr. Paul Montagna, May 17, 2021.
4. Mr. David Batker (Bakter Consulting, LLC), Economic Damages to the Fishing and Shellfish Industry as a Result of the May 10, 2019, Shipping Collision and Reformate Spill, May 17, 2021.
5. Mr. Ralph A. Litolff (RAL Forensics, L.L.C.), Plaintiff / Claimant: Gulf Coast Oyster, Inc., May 17, 2021.

5.1 Report of Claimant's Expert, Gabriel Johnson for Shrimps-R-Us

The Mr. Johnson's report states that "It is quite obvious that the chemical spill in May, 2019 had a direct and immediate impact on the oyster crops in Galveston Bay" without providing any direct evidence other than oyster mortality data (Johnson 2021a). No discussion was provided to eliminate other common causes of oyster mortality and no consideration was given to the long-term decline in oyster populations reported in State of the Bay (HARC (Ed.) 2020). There is no recognition of the impacts from Hurricane Harvey on the bay environment or steps taken to correlate conditions pre- and post-Hurricane Harvey site conditions. The report did not use standard statistical methods to collect or analyze samples and then comes to unfounded and unreliable conclusions.

5.1.1 Methods

In Mr. Johnson's reports, there was insufficient information to allow for a scientific review of results. Important factors used to determine the quality of a study that were missing included the number of samples, sampling locations, variability observed, power of the analysis, age of cultch material sampled, and diver observations of cultch material including any sedimentation of cultch material. Only one piece of information about sampling was shared: the author stated that samples were collected at "non-random sampling locations" (Johnson 2021a). To accurately estimate population size of any sessile organism, multiple samples need to be collected in a random or stratified random sampling design. The randomness of sampling locations is required to overcome the tendency humans have of unconsciously selecting non-representative locations (those that are easier to access, those that have more or fewer of the desired organism, etc.). Statistical analyses assume that selected locations sampled are representative of the population. If the assumption of representative sampling is violated, statistical results are invalidated, making this study unreliable.

Because sampling locations and numbers of samples were not disclosed, it is not possible to determine whether sufficient sampling took place. We could not calculate a variance based on the data provided, which is key to determine whether findings are statistically significant or just due to data variability.

There is also no basis to support drawing the correlations of values between different leases or over time for any given lease. Mr. Johnson reports percent mortality of recently dead oysters for lease 427A of 8% to 70.6% for years 2015 to 2017 without any dates for when the sampling was performed. These values are then averaged to calculate a mean natural mortality of 35% and then claims the 2019 percent mortality of recently dead oyster when discounted for natural mortality is 38.47%. However, given the increasing nature of the mortalities and that 2017 was 70.6%, it could be that 73.67% is just natural mortality.

Using a nonrandom sampling methodology for sampling the oyster leases would invalidate the statistical assumptions necessary to calculate an average across the lease. Picking areas with oysters for sampling and then applying those values across in the entire area where large portions were known not to contain oysters in 2015 based on the water bottom surveys provided in the report (Johnson 2021a) is not a reasonable or defensible method for calculating the sacks per acre. The equation would need to have an adjustment factor such as % of acres with viable oyster bottom. Furthermore, the assumption that the area with viable oyster bottom is the same as it was in 2015 is clearly not a reasonable assumption when the wettest hurricane in US history impacted the area in 2017 depositing 18 years' worth of sediment into the Bay as previously discussed.

5.1.2 Findings

The comparison of pre-Hurricane Harvey site information, especially the poling surveys, is not appropriate given the significant amount of sedimentation that occurred associated with Hurricane Harvey. This area was estimated to receive 10-15 cm of deposition during Hurricane Harvey (Du et al. 2021). This may have been even greater for oyster reefs where the rough nature of the bottom could capture greater amounts of sediment.

Given extended salinity values below 5 PSU observed from mid-May through the end of May 2019 caused by influx of freshwater at or above flood stage, the expected mortality for 15 days from the Du et al. 2021 report (slope 4.02±1.39) the range of expected mortalities with a 95% confidence interval would be 39.45% to 81.15% with a mean of 60.3%. The extended period of low salinity could explain the observed recent mortalities around the same time as the spill.

The photo of dredged oysters in figure 2 from the Mr. Johnson's expert reports showed oysters from lease 430A had a brown color (Johnson 2021a, 2021b). The brown color associated with oyster mortality was also observed following Hurricane Harvey when mortality was attributed to low salinity (Du et al. 2021). This is another indicator that low salinity was the most likely cause of the recent oyster mortalities observed by MREC.

Therefore, the lack of sampling rigor, lack of addressing differences pre- and post- Hurricane Harvey in the correlations, lack of addressing the low salinity, the lack of addressing any of the other common reasons for oyster mortality and the lack of providing any direct connection to the reformate spill, makes the conclusions unreliable and not based on sound science.

5.2 Report of Claimant's Expert, Gabriel Johnson for Ivo Slabic

Mr. Johnson's report again states that "It is quite obvious that the chemical spill in May, 2019 had a direct and immediate impact on the oyster crops in Galveston Bay" without providing any direct evidence other than oyster mortality data (Johnson 2021b). The same concerns raised on the Johnson report for Shrimp R US are applicable to this report as well.

Mr. Johnson's report for Ivo Slabic was based on even less relevant information than the Shrimp R US report. The report states that no samples were taken in the 430A lease in 2019 and correlations were calculated based on pre-Hurricane Harvey conditions with neither evidence provided to support the statistical basis for the comparison nor evidence supporting that mortality was due to toxicity (Johnson 2021b).

The same issues exist for this report by Mr. Johnson as with the Shrimp R US report that he also authored. It is not based on sound science and reaches unreliable conclusions.

5.3 Report of Claimant's Expert, Dr. Paul Montagna

Dr. Paul Montagna's expert report listed many unsubstantiated statements in relation to the applicability to this spill and generalized conclusions about how oil spills interact with the environment. Dr. Montagna does not mention how a spill of reformate is different from that of a crude oil. For example, several references in the Montagna report are related to crude oil which has significantly different characteristics and recovery periods from those of reformate or other gasoline range hydrocarbons. Montagna references a recovery period from oil spills in estuary habitats taking from 3 to 10 years in the 2011 ITOPF reference (International Tanker Owners Pollution Federation (ITOPF) 2011). In the case of this spill, the impacts were likely associated with plankton and minor impacts to sand beaches and exposed rocky shoreline west of the spill location. The referenced ITOPF article provided the following table (Table 4), which only shows Mangrove habitat taking 10 years. Mangrove habitat is not present at the site.

Table 4: Recovery Period Ranges for Various Habitats (International Tanker Owners Pollution Federation (ITOPF) 2011)[3]

Habitat	Recovery period
Plankton	Weeks/months
Sand beaches	1 – 2 years
Exposed rocky shores	1 – 3 years
Sheltered rocky shores	1 – 5 years
Saltmarsh	3 – 5 years
Mangroves	10 years and greater

Reformate is a lighter refined product of oil that is a component of gasoline and not a heavy crude oil. The ITOPF report mentions that lighter oils can have a higher biological availability and damage through toxicity in the immediate vicinity of a spill, but their rapid dissipation through

[3] Reproduced with permission from the ITOPF report. Table 1Indicative recovery periods after oiling, for various habitats. The period is dependent on many factors including the amount and type of oil spilt. Recovery is defined here as the point at which the habitat is functioning normally.

evaporation and dispersion would mean less damages overall in comparison to heavier crude oils (International Tanker Owners Pollution Federation (ITOPF) 2011). The biodegradation half-life for gasoline solubilized in surface waters is only about 5 days (Prince, Parkerton, and Lee 2007). However, evaporation of the free-phase reformate and volatilization of compounds from the water column are expected to account for most of the reformate removal from the system. Dr. Montagna does not discuss how the chemical difference between reformate and crude oil influence the degree and spatial extent of the impacts.

Dr. Montagna states "it is known that the chemical was widely dispersed in critical habitat areas" without providing any further characterization of the location or areas impacted. This statement then led to hypothetical scenarios of impact and chronic effects over a period as long as 10 years. Dr. Montagna does not address the potential for rapid evaporation of the spilled material, which is a major omission in this analysis, making it unreliable. Evaporation has been shown to be important in reformate spills. The LSU RCAT evaporation evaluation, showed that the reformate sample mass reduced by 65% after 4 hours of evaporation (LSU RCAT Team 2019). The Journal Article by Pimsee et al. (2014) states that the fate and mobility of PAHs in the environment are mainly controlled by their chemical properties (Pimsee et al. 2014). Therefore, lumping all oil compounds together into an evaluation of the potential impacts on an aquatic environment is not appropriate or supported by the scientific literature.

5.4 Report of Claimant's Expert, David Batker

The Batker report does not provide an estimate on the amount of shrimp, fish or oysters impacted by the spill nor does it discuss other possible explanations for more challenging fishing or guiding seasons unrelated to the spill. As previously presented, the extended periods of low salinity related to freshwater inflows are the likely causes of impacts across the bay.

The report also inaccurately compares the spill of reformate to a spill of crude oil. While both are petroleum materials, the nature of the corresponding impacts are very different (International Tanker Owners Pollution Federation (ITOPF) 2011). The reformate material is a lighter oil material that evaporates and biodegrades more quickly than heavier crude oils so the impacts where likely acute in nature and recovery would occur more quickly (International Tanker Owners Pollution Federation (ITOPF) 2011).

The Batker report quotes portions of the notice from the Texas Department of Health Services (TDHS) issued on May 12, 2019 related to temporary closure of private oyster harvesting and a temporary warning not to eat seafood from Galveston Bay. However, these quotes are taken out of context; the Batker report does not quote portions of the notice that relate to the temporary nature of the effects. The TDHS notice on May 12, 2019 also stated the following (Galveston County Health District 2019):

- "…the spill is not affecting the entire area…",
- "The chemical involved, a gasoline additive called reformate, evaporates quickly and is not expected to accumulate in fish tissue once it's gone from the water, so any impact on seafood should be resolved in the coming days or weeks.", and
- "Exposure to the chemical vapor does not pose a long-term health concern,…"

Therefore, claims running into months and years are not supported by the available data, nature of the spill or the public agency response to the spill. This report also does not provide any direct connection between the reformate spill and actual impacts to aquatic species.

5.5 Report of Claimant's Expert, Ralph A. Litolff, Jr.

The Litolff report concerning the economic damages sustained by Gulf Coast Oysters, Inc. (GCO) states "It is our understanding that GCO was located in an area impacted by the spill and sustained economic damages beginning on or around May 10, 2019 and continuing through at least April 30, 2021, the date of this report." The report provides no information on the direct exposure of GCO or any other oysters to reformate compounds and does not seek to address any of the other plausible explanations for changes in the oyster business. The entire basis of the report is flawed and without merit.

6. OPINIONS

6.1 Opinion 1

Given the volatile nature of reformate, the spilled reformate likely evaporated quickly from the surface of the water and the fraction that dissolved into the water column likely also attenuated quickly.

6.2 Opinion 2

The spill most likely impacted aquatic biota in a limited area for a few hours to a few days near the spill site and to the west based on the hydrodynamic modeling and attenuation of the free phase product. The limited nature of the impacts is also supported by the observation of only one fish kill of between 100 and 1000 fish, crabs, and shrimp during the spill response. Teams including state and federal representatives were out surveying the situation during the spill looking for impacts and only one location was identified.

6.3 Opinion 3

Given the limited impacts observed in proportion to the overall bay, it is unlikely that the spill had a significant impact on the shrimp, oyster, and fish populations in the system.

6.4 Opinion 4

The analyses from the water samples collected in the vicinity of the private oyster leases do not indicate that the reformate constituents impacted the oysters.

6.5 Opinion 5

The comparison of oyster lease production prior to and after Hurricane Harvey is not appropriate without significant sampling in a statistically valid manner to account for changes in the reefs and viable oyster habitat. Therefore, the conclusions by Mr. Johnson related to correlations of conditions pre- and post-Hurricane Harvey are not reliable or supported by sound science.

6.6 Opinion 6

The impacts from the spill were not likely to have long-term impacts due to the rapid attenuation of the reformate.

6.7 Opinion 7

Salinity was low for extended periods of time during 2019 due to large amounts of freshwater inflow to the bay. This is likely to have caused reductions in shrimp and oyster populations and their corresponding harvest. There was an extended period of salinity below 5 Practical Salinity Units (PSUs) in Galveston Bay near private oyster leases 390A, 391A, 392A and 432A in the second half of May 2019, unrelated to the spill, that is a likely cause of oyster mortalities.

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APPENDIX 1
CV FOR CORD HARRIS
CV FOR LIS NELIS
CV FOR SHAUN GANNON

CORD HARRIS

Senior Managing Consultant

Cord Harris has over 19 years of professional experience managing environmental liabilities, including 10 plus years inside Fortune 500 or Fortune 100 energy companies. He has extensive experience assessing site conditions, developing and implementing remedies, negotiating agreements with private and public stakeholders, public relation management, and supporting litigation efforts for a broad range of environmental impacts. Mr. Harris has managed sites in 10 different states under various local, state and federal oversight and regulatory programs including CERCLA, RCRA, CWA as well as state and local programs. He has worked closely with legal teams both as an in-house client and as a consultant negotiating settlements and/or preparing for litigation.

In the oil and gas industry he has managed site liabilities ranging from well head blow-outs, gathering system failures both for natural gas and crude oil, compressor stations, pumping stations, gas processing plants, refineries, fuel product distribution systems, and retail gas station clean-ups. This work involved stakeholder management, consultant and field team coordination with other companies, landowners, regulators and the general public.

Mr. Harris has also managed site liabilities associated with mining sites from small glory holes to the largest superfund site complex in the United States. These sites were associated with mining and processing of silver, gold, lead, copper, magnesium, aluminum, molybdenum, phosphate, sulfur, arsenic and uranium. Some sites had extensive histories dating back to the 1860s that was important to understand when developing remedies and allocating costs.

CONTACT INFORMATION
Cord Harris

charris@ramboll.com
+1 (832) 258-4338

Ramboll
10333 Richmond Avenue
Suite 910
Houston, TX 77042
United States of America

EDUCATION

Ph.D., Civil Engineering
Texas A&M University – Dissertation - *Biodegradation of Polycyclic Aromatic Hydrocarbons and other Petroleum Compounds*

M.S., Civil Engineering
Texas A&M University – Thesis - *Available Nutrient Dynamics in Marsh Sediments Contaminated by an Oil Spill Following a Flood*

B.S., Civil Engineering
Texas Tech University

CAREER

2021 – Present
Senior Managing Consultant, Ramboll US Consulting

2011 – 2020
Commercial Portfolio Manager (2017-2020)
Liability Business Manager (2011-2017)
BP, Mining, Remediation Management

2007 – 2011
Principal Engineer, URS Corporation, Santa Ana, CA

2006 – 2007
Principal Environmental Representative, El Paso Energy Services, Houston, TX

2004 – 2006
Unit Leader – Seconded Staff at El Paso, URS Corporation, Houston, TX

2002 – 2004
Senior Project Manager, ERM Southwest, Houston, TX

PROFESSIONAL CERTIFICATIONS

Professional Engineer – Texas 2004

HYDROCARBON RELATED PROJECTS

Managed a portfolio of petroleum related clean-ups in South Texas dealing with pipeline leaks and various storage facilities for crude gathering, jet fuel, and gasoline.

Program Manager/ Southern California UST Program of up to 150 retail sites involving 4 offices. Sites in the portfolio ranged from initial site assessments (often associated with due diligence activities from property disposition), active remediation, and final site closures.

Supported a litigation project, as a principal in the field, in Carson, CA for a confidential client involving a neighborhood built over a former tank farm.

Supported advocacy and marketing through participation in the Western States Petroleum Association (WSPA).

Managed a Phase 1 and Phase 2 due diligence investigation for an international client related to potential facility acquisition in Southern California.

Managed portions of an RFI investigation and assessment for a large petrochemical facility for an Oil & Gas Major.

Assisted in litigation support involving pesticides in sediment dating back to the 1950s. This project involved an extensive review of Army Corp of Engineer dredging records and practices associated with the use of contaminated sediment disposal facilities.

Performed and managed Screening Level Ecological Risk Assessments and site assessment to support risk-based corrective action remedy selection and implementation at multiple sites.

Conducted treatability studies involving bioremediation and chemical oxidation of various

compounds.

Performed evaluations on the petrophysical properties of non-aqueous phase liquids in soil to evaluate the need or expected efficacy of various remedial strategies.

Managed a remediation site along a ship channel with free phase hydrocarbons that periodically required spill notification and response due to sheens on the surface water.

MINING RELATED PROJECTS

Managed the regulatory negotiations for large mine NPL site closures in southwest Montana. These negotiations were complex due to significant challenges related to the application of the CWA in the middle of a communities and adjacent to other commercial, agricultural and industrial sources. A consent decree agreement for Butte Priority Soils OU was reached in late 2019 and entered by the federal district court in 2020.

Managed a large copper mine site that was slated for listing on the CERCLA National Priority List in Nevada, which was avoided and instead regulated by Nevada Department of Environmental Protection. This is expected to result in a much more efficient and cost-effective remedy.

Managed the development or modification of several long-term institutional controls and private residential property remediation programs. These programs involved community ordinances that allowed for development in a safe manner based on human health risk-based corrective actions.

Developed cost allocation scenarios for several different sites. In some cases, this involved extensive historical record searches, review of past site practices and aerial photos, maps and various site characteristics.

Supported corporate legal teams defending or litigating claims against other parties related to costs incurred from environmental or remedy construction related impacts. The claims included property damage claims, restoration claims, contribution allocation, CERCLA liability, personal injury, and private restoration claims. The cases ranged from negotiations prior to formal filing, to state courts, to federal district courts, to State Supreme Courts, to a Hearing of Cert in front of the Supreme Court of the United States.

Negotiated site clean-up standards and remedial actions for a CERCLA mine site closure in California. The project team pursued an Early Final Remedial Action to advance the site and provide certainty in the remedy obligations.

Negotiated a cash-out settlement with the US Forest Service associated with the remediation of a uranium mine in Colorado.

Negotiated a waste-in-place remedy with a property owner that reduced the safety risks, provided greater certainty on the project completion and saved over $2 million dollars.

Provided input on the technical aspects of a Montana legislation that was crafted to require MDEQ to consider the financial burden of the enforcement of standard changes. This bill was approved and signed into law.

Provided input to political action groups and legislators concerning proposed state and federal legislation, which required reporting lobbying efforts in accordance with different disclosure requirements.

LIS CASTILLO NELIS

Lis Nelis has 17 years of biodiversity, invasive species, environmental science and project management experience, with particular expertise in analysis of the effects of anthropogenic disturbances on ecosystems. She applies her expertise in remediation, environmental damage assessments, ecological risk assessments, lender due diligence, analysis for sensitive species, and restoration of natural systems. Lis has worked on disturbances from chemical and oil spills, invasive species, grazing, erosion, and climate change. She is experienced in planning studies for restoration, management, conservation, and monitoring. She is also accomplished at integrating field data into mathematical models to predict long-term ecosystem outcomes. She uses her extensive analytical and programming skills to characterize, analyze, and model large data sets to support her clients. Lis has worked in many areas of the United States and in several countries in Latin America. She has provided scientific and strategic consultation to government agencies on management plans for a national park.

EDUCATION

Postdoctoral Fellowship, 2012
Stanford University, Stanford CA, United States
Fellowship Research: Interactions among invasive ants and plants

Ph.D., Evolutionary Biology, 2008
University of Chicago, Chicago, IL, United States
Dissertation: An Investigation of Synergistic Interactions Among Invasive Species of Plants and Animals

M.S., Evolutionary Biology, 2004
University of Chicago, Chicago, IL, United States
- Smithsonian Institution, Monitoring and Assessment of Biodiversity Course 2003
- Organization for Tropical Studies, Tropical Ecology and Biodiversity Course 2003

Honors B.S., Environmental Biology, 2000
Michigan State University, East Lansing, MI, United States
Wildlife Biodiversity and Management, Various Parks, Kenya
Spanish Language and Culture, Cáceres, Spain

CERTIFICATION

Certified Senior Ecologist, Ecological Society of America

LANGUAGES

Spanish: Fluent (oral and reading), Conversant (writing)

CONTACT INFORMATION

Lis Castillo Nelis

lnelis@ramboll.com
+1 (206) 336-1659

Ramboll
901 Fifth Avenue
Suite 2820
Seattle, WA, 98164
United States of America

SELECTED PROJECT WORK

Natural Resource Damage Assessment, Biodiversity Assessments, and Litigation Support

Harm to Human Health from the Consumption of Shellfish – As part of litigation support on behalf of Linklaters, Dr. Nelis and her team investigated the causes of human sickness due to consumption of raw or cooked shellfish, and the possible effects of wastewater effluent on shellfish consumed by humans.

Carrying Capacity Assessment for Oysters, Clams, and Geoducks – On behalf of Taylor Shellfish, Dr. Nelis was the expert consultant that conducted an analytical carrying capacity assessment to support their Environmental Impact Assessment for a proposed aquaculture expansion. Dr. Nelis analyzed current and proposed levels of oyster, clam, and geoduck aquaculture in the specified waterbody and opined on the sustainability of expanding aquaculture.

Microplastics and Shellfish Aquaculture – On behalf of Plauché and Carr, Dr. Nelis managed a project to review current literature on marine microplastics, their origins, the contribution of aquaculture to marine microplastics, and the content of microplastics in farmed shellfish.

Oil Spill Effects on Shellfish and Crustaceans – On behalf of a confidential client that was involved in an oil spill, Dr. Nelis reviewed the plaintiff's claims of damages to the oyster and shellfish harvest. She also reviewed the historic oyster and shrimp population dynamics, salinity, and other potential environmental causes for population declines. Dr. Nelis contributed her findings to an expert report.

Habitat Equivalency Analysis (HEA) in preparation for PFAS litigation – In support of a major manufacturing facility which used PFAS fire suppression foams, Dr. Nelis managed a team to calculate the potential financial damages that could result from an NRD suit due to PFAS contamination. Dr. Nelis used a HEA framework to determine the best, worst, and most likely scenarios for required mitigation to help the manufacturing firm estimate the needed financial reserve.

Bovine spongiform encephalopathy (BSE; mad cow disease) litigation support – In defense of the Canadian Food Inspection Agency, Dr. Nelis managed a team supporting Dr. Joseph Rodricks in the preparation of his expert report and litigation presentation. Dr. Nelis reviewed historic documentation about the science of BSE at the time of the case, analyzed quantitative risk analyses performed in the 1990s, and contributed to and edited the expert report.

Siting for Land-Based Aquaculture - To support a European land-based aquaculture corporation, Dr. Nelis worked with a team to identify areas on the West Coast of the United States that would be best suited for a new land-based aquaculture facility. The team reviewed physical, biological, and climatological variables to assist the corporation in selecting a location for the new facility.

Marine Deep-Water Oil Spill Biological Organism Analysis – In support of NRD litigation for a confidential client, Dr. Nelis characterized over 30 years of government-collected marine background data to clarify sampling methodology changes over time. She used these data to determine whether there was a change in baseline abundance for many species of marine plankton, invertebrates, and fishes before and after an incident. She also used the data to parameterize loss calculations to inform financial settlement metrics for litigation support. As part of her work, Dr. Nelis programed a spatial model in R to calculate the loss of organisms for the NRD case.

Marine Shallow Water Oil Spill Habitat Analysis – Dr. Nelis evaluated and summarized the biology and habitat preferences of marine vertebrates to determine the likelihood of their habitat intersecting with the area affected by a small nearshore oil spill as part of a NRD case.

QAPP for Plant Sampling – At the request of a confidential client in the United States, Dr. Nelis wrote the Field Sampling Protocol, the Standard Operating Procedures, and managed the production of a Quality Assurance Project Plan (QAPP). The QAPP was designed to collect plant samples for analysis to determine levels of lead and other metals in plant tissues. As part of this project, Dr. Nelis collaborated with the client, the Environmental Protection Agency, and fieldwork subcontractors, and conducted oversight of field sampling collection and processing.

Damage Assessment for Biodiversity and Ecosystem Services of a National Park – Dr. Nelis managed and contributed heavily to an expert report for the defendant, the Dominican Republic, that had been sued to allow a luxury housing development within a national park. Dr. Nelis and her team investigated the biodiversity of the park and surrounding area and opined on the environmental damages the housing development would have on the biodiversity and the ecosystem service provisioning of the park.

Sensitive Species Review – At the request of Pacific Raceways, a King County, WA industrial land owner, who wished to develop an additional 30 acres of their property, Dr. Nelis did the desktop review and field survey for sensitive plants, mammals, fish, and birds. Dr. Nelis contributed her findings to the opinion letter that the client presented to regulators.

SEPA Checklist – Dr. Nelis did the environmental portion of the Washington State Environmental Policy Act (SEPA) Checklist, on behalf of a client who wished to develop a manufacturing plant in Pend Oreille County. Dr. Nelis did the desktop review of sensitive species and hired and managed sub-contractors to do the field review of the site. She then produced the written deliverable in collaboration with the Ramboll teams that conducted the air and water analysis of the site.

Biodiversity Change Analysis – On behalf of a major international energy company, Dr. Nelis managed a project to explore the change in habitat quality of a tropical forest due to colonization and petrochemical extraction. Her team used a GIS habitat analysis based on ICUN population data to estimate the potential biodiversity in the area. Dr. Nelis designed the geospatial model in collaboration with a GIS expert, analyzed the results, and wrote a manuscript for publication.

Audit Environmental Impact Assessment (EIA) for Dairy Farm Expansion – At the request of a neighbor of a planned expansion of a dairy farm, Dr. Nelis audited an EIA for inclusion of all local endangered and threatened species, revised suggested sampling and monitoring protocols, mapped the connectivity between the terrestrial and marine community via streams though the property, and compiled a report from multiple experts. The client then used the report to protest the planned expansion of the farm which they considered likely to become a nuisance due to poor environmental planning.

Habitat Equivalency Analysis (HEA) on Damaged River Banks – Due to a dam failure in Latin America, the banks of a river were damaged. Dr. Nelis collected restoration and resiliency information about the habitat, parameterized, and ran a HEA Analysis. GIS experts and local habitat experts collaborated in the work by providing areas of each habitat damaged and local environmental knowledge. Dr. Nelis combined their information with her analysis, developed graphics, produced a presentation for the client, and finalized the project by presenting results in a report.

Environmental Impact Assessments and Lender Due Diligence

Independent Biodiversity and Environmental Due Diligence – Dr. Nelis analyzed the Biodiversity and Environmental components as an Independent Environmental and Social Consultant (IESC)/Environmental and Social Due Diligence (ESDD) review of a proposed 2.0 billion cubic feet per day, 450 mile natural gas pipeline extending from the Permian Basin in West Texas to delivery points along the Gulf Coast. Dr. Nelis summarized the environmental and biodiversity effects of the Project; evaluated the adequacy of the Project's mitigation and management measures; reviewed permit documents for and by regulators; recommended the categorization of the Project as defined under the 2013 Equator Principles (EPIII); and identified any significant instances where the project was not in alignment with the International Finance Corporation (IFC) Performance Standard 6.

Biodiversity Monitoring Study Due Diligence – At the request of a lender, Dr. Nelis audited the biodiversity monitoring and sampling plans of TRECSA, an energy project in Latin America, to ensure that the planning and implementation of the study followed the International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability (2012). She analyzed the sampling and monitoring methodologies for both plants and animals, in the field and through desktop reviews, reviewed the experience of monitoring staff, and examined initial results to insure appropriate measures had been taken to insure IFC compliance.

IFC Performance Standard 6 Compliance – On behalf of Konzo Techno City, Kenya, Dr. Nelis reviewed biodiversity, habitat, and ecosystem information to ensure that sampling and documentation was compliant with International Finance Corporation (IFC) Performance Standard 6 before construction of the new Technopolis proceeded. Dr. Nelis also discussed data gaps with the project team and reviewed the final report.

IFC Performance Standard 6 Review – At the request of EM Power, Dr. Nelis reviewed two different sites in Mexico for compliance with International Finance Corporation (IFC) Performance Standard 6 and made recommendations for becoming compliant in instances when improvements were necessary.

Project Compliance with Lender Requirements – Gulf Coast Ammonia asked Dr. Nelis and her team to organize the data collected in compliance with laws in the United States of America into a format acceptable to international funding bodies. Dr. Nelis analyzed information available for the site of the proposed development, did a gap analysis, and made recommendations on further work needed for compliance.

Remediation, Restoration, and Nature Based Solutions

- Nature Based Solutions Training – To support new sustainability goals for a major energy and mining company, Dr. Nelis managed a team to create and present educational workshops for project managers on nature based solutions, ecosystem services valuation, biodiversity, and other topics to help managers align their project goals with larger corporate sustainability goals.

- Support for a Conservation Easement and Planting Plan to Restore Motocross Tracks – At the request of Pacific Raceways, a King County, WA industrial landowner, Dr. Nelis managed a team and conducted the fieldwork to restore motocross racetracks through a Pacific Northwest forest. Dr. Nelis hiked and documented the field site, worked with her team to write a restoration plan, and then modified the plan according to feedback from the county.

- Restoration Preparation for Wetland and Upland on the Boise River - On behalf of the Idaho Foundation for Parks and Lands, a not-for-profit, Dr. Nelis managed a team to help begin the

production of a master plan to restore the Barber Pool area to its natural wetland state. Dr. Nelis' team advised the client about grant opportunities, did a gap analysis of their existing data and documentation, and produced a final summary document that could be used to solicit further funding.

Support for Restoration and Negotiation – In support of a small mining corporation, Dr. Nelis managed the writing of a restoration plan for a portion of their land along a moderately sized river. In addition, she helped them determine what their likely culpability was for the accidental placement of material on a potential wetland and supported them as they worked with Washington Ecology to mitigate the situation.

- Review and Analysis of Plant Sickness - On behalf of a mining corporation, Dr. Nelis managed a team to conduct a field and desktop review of some areas near the mine site that had unhealthy plants, alleged to be caused by the mine. Dr. Nelis' field team reviewed the area, similar areas outside of the influence of the mine, and also researched other likely causes for the decline in plant health.

- Experimental Remediation of Lower Duwamish Waterway – Dr. Nelis worked as part of team of multiple consultant companies to provide support to the Lower Duwamish Waterway Group as they tested clean enhanced natural recovery layers with and without activated carbon to decrease PCB entry into the waterway. Dr. Nelis conducted sediment sampling, statistical analysis of outcomes, writing, and management of the project.

- Arsenic Contamination – On behalf of a confidential client, Dr. Nelis analyzed the levels of arsenic in an area surrounding an acknowledged point source to identify additional inputs of arsenic into the waterway of concern. She analyzed the local habitat to qualify the loss in ecosystem services that would occur given full soil remediation and vegetation removal.

- Sampling Design for Remediation of PCBs – On behalf of a confidential client, Dr. Nelis worked with GIS staff to analyze the samples that were collected from a waterway historically contaminated by PCBs, and to analyze where further samples were likely to be useful and where they were likely to add little to the investigation. This information was used by the client in their discussion with regulators who were requesting extensive additional sampling.

Toxicology, Risk Assessment

Selenium and Mercury Relationships in Fish – At the behest of the Electric Power Research Institute (EPRI) Dr. Nelis worked with data from several data bases to calculate three different selenium and mercury indices that determine the safety of wild-caught fish for human consumption. She used the Selenium-Mercury molar ratio, the Health Benefit Ratio (HBV) and the Benefit Risk Value (BRV) to compare fish data among the three ratios and make recommendations about which to use under which situations.

Bioaccumulation of formaldehyde – Following contamination of a waterway with formaldehyde, Dr. Nelis did a literature review of the potential for bioaccumulation and transfer to humans through fish consumption.

Analyte Analysis for Manufactured Gas Plant (MGP) Cleanup – Dr. Nelis analyzed analyte levels using ProUCL and R for a report for the Environmental Protection Agency (EPA) documenting the cleanup of a site previously used as a Manufactured Gas Plant. She also wrote R programs to automate the creation of tables for EPA-required documentation.

Recreation of Heavy Metals Recovery Process – Dr. Nelis read, summarized, and translated Spanish-Language documents from the 1970s relating to a closed processing plant to help a team of engineers reconstruct the process and materials used in the plant; the plant recovered heavy metals from industrial waste. She also acted as an interpreter during multi-national phone conferences to share information between the affected parties and the local contractors doing the investigation. She also contacted local organizations by phone and email to obtain the GIS and mapping documents necessary for the work.

Heavy Metal Contamination Through Food – Due to a site locally contaminated with heavy metals near the coast, separating the effects of heavy metal consumption through fish versus dust was necessary. Dr. Nelis investigated the local diet of a South American city to discover the quantity of fish consumed. After it because clear that there were no quantitative academic publications, she used Spanish-language food blogs and local tourist internet sites to develop a qualitative picture of the local diet. She also translated a food survey carried out by a local sub-contractor for analysis.

Analysis of Environmental Compliance in Latin America – For an energy plant under construction in Cartagena, Dr. Nelis scanned through development documents to summarized and translate compliance issues from Spanish to English.

Mathematical Modeling and Statistical Analysis

Modeling Zika Virus – On behalf of the U.S. Military, Dr. Nelis programed a dynamic transmission model to test the effectiveness of vaccination, personal protective measures, and mosquito control at reducing morbidity within US military populations. Zika transmission was modeled as a compartmental susceptible – exposed – infected – removed (SEIR) model employing structured ordinary differential equations. The model tracked interactions between humans and mosquitos and incorporated seasonality of mosquito populations and the potential for herd immunity. Human populations were modeled as those expressing symptomatic and asymptomatic infection. The transmission model was calibrated against data collected by public health authorities in Puerto Rico in 2016; sensitivity analyses were performed on model parameters and interventions.

Modeling Norovirus – On behalf of the U.S. Military, Dr. Nelis programed a mathematical model of norovirus transmission. The model tested the effectiveness of wide-spread norovirus vaccination in close-quarters settings as a compartmental susceptible – exposed – infected – removed (SEIR) model employing structured ordinary differential equations. The model included symptomatic and asymptomatic infection, genetic resistance, vaccination, and the potential for herd immunity effects. The transmission model was calibrated against data from a norovirus outbreak within populations in a university setting and sensitivity and uncertainty analyses were also performed.

Modeling Hospital Acquired Infections (CREs) – Dr. Nelis programmed a model to track the spread of multi-drug resistant organisms, particularly carbapenem-resistant Enterobacteriaceae (CRE), within the hospital setting. The system was modeled as a compartmental susceptible – exposed – infected – removed (SEIR) model employing structured ordinary differential equations. The contact rate between patients, hospital staff, and the environment were incorporated into the model. The model will be fit to data on antibiotic use, infection rates, resistance patterns, and incoming carriage rates, and will examine the impact of interventions to reduce the incidence of CRE during a hospital stay.

Biodiversity Damages Assessment for Net-Pen Aquaculture - Dr. Nelis statistically analyzed the difference in biota below net-pens and at different distances from the net-pens to quantify the loss in biodiversity due to aquaculture versus the loss in biodiversity due to the use of episodically administered medications on the penned fish.

Agricultural Plant Research

Publication Editing – At the request of a faculty member now in the role of a dean, Dr. Nelis was retained to combine a master's thesis and a poster about transgenic corn into a paper for publication in a scientific journal. Her work included deciphering a partially complete statistical analysis, identifying gaps in the research, writing the paper, formatting it for the correct journal, and editing the final project.

Urban Planning

Integration of Biodiversity into Planning and Urban Development – Biodiversity expert at Young Planners Summit in Hudson, NY, where an integrative team of urban planners, engineers, toxicologists, human health experts, economists, and sustainability experts worked together to develop plans for the redesign of the waterfront and surrounding neighborhood. The plan was designed to increase waterfront use by the all economic levels of the community and to make it an attractive draw for tourists. Dr. Nelis contributed her knowledge as a biodiversity expert and as a Latina to incorporate the use of native flora throughout both high and low income areas of the town to provide a uniform and inviting feeling for all members of the community.

PUBLICATIONS

Burgess C, LC Nelis, C Huang. Modeling the Potential Impact of Norovirus Vaccination among DoD Forces. 2021. Military Medicine.

Burgess C, LC Nelis, C Huang. Modeling Zika Vaccination Combined with Vector Interventions in DoD Populations. 2021. Military Medicine.

Nelis LC. Life form and life history explain variation in population processes of a grassland community invaded by exotic plants and mammals. PLoS ONE 2012; 7(8):e42906.

Nelis LC. Grouping plant species by shared native range, and not by native status, predicts response to an exotic herbivore. Oecologia 2012; 169(4):1075–1081.

Nelis LC, Wootton JT. Treatment-based Markov Chain Models clarify mechanisms of invasion in an invaded grassland community. Proceedings B, The Royal Society of London 2010; 277:539–547.

Schmidt KA, Nelis LC, Briggs N, Ostfeld RS. Invasive shrubs and songbird nesting success: Effects of climate variability and predator abundance. Ecological Applications 2005; 15(1):258–265.

PRESENTATIONS

Johansson L, Nelis L. INTERNATIONAL PERSPECTIVE: Make Urban Nature Work for You! Case Studies from Sweden Introducing an Ecosystem Services Perspective to Urban Management. Public Works Expo (PWX) 2019.

Burgess C, Nelis L, Huang C, Masse L. Modeling zika vaccination combined with vector interventions for outbreak response in DoD populations. Military Health System Research Symposium 2019.

Burgess C, Nelis L, Huang C, Masse L. Modeling the potential impact of norovirus vaccination among DoD forces. Military Health System Research Symposium 2019.

Nelis LC, Mandel R. Site-specific restoration on abandoned mine sites in White River National Forest. Ecological Society of America, 2019.

Nelis LC, Tubbesing C, Parnwell E. Santa Clara Island: stuck in an exotic alternative stable state. Ecological Society of America, 2017.

Nelis LC, Ladau J, Sanders NJ, Fitzgerald K, Heller NE, Appel JS, Gordon DM. The impact of the invasive Argentine ant (*Linepithema humile*) on association network structure of native ant species in Northern California. Ecological Society of America, 2012.

Nelis LC. Do population dynamic parameters differ between native and exotic grassland species? Ecological Society of America, 2010.

Nelis LC. A double-blind study with Argentine ant researchers: Do native and exotic plants have fundamentally different roles in the community? Ecological Society of America, 2011.

Nelis LC. Effects of exotic herbivores and disturbance on invasion success: Does shared evolutionary history matter? Ecological Society of America, 2008.

Nelis LC. An investigation of synergistic interactions among invasive species. Ecology and Evolution Departmental Natural History Seminar, University of Chicago, 2008.

Nelis LC, Wootton JT. Using Markov models to examine mechanisms of interaction among multiple invasions on Robinson Crusoe Island, Chile. Ecological Society of America, 2007.

Nelis LC. Effects of invasive rabbits on exotic grassland plants. Ecology and Evolution Departmental Natural History Seminar, University of Chicago, 2007.

Schmidt KA, Nelis LC, Briggs NM, Ostfeld RS. Climatic variability and predator abundance mediate the interaction between an invasive shrub and nesting success in a woodland songbird. Ecological Society of America, 2004.

PEER REVIEWER

- Proceedings B of the Royal Society of London
- PLoS ONE
- Journal of Applied Ecology

PROFESSIONAL AFFILIATIONS

- Society of Environmental Toxicology and Chemistry
- Ecological Society of America
- Society for the Advancement of Chicanos and Native Americans in Science—SACNAS
- Society of Ecological Restoration

RAMBOLL

WATER

SHAUN B GANNON

SME/Technical Manager

Mr. Gannon has extensive experience in hydrologic and hydraulic modeling related to flood resiliency, watershed management, dam safety, interior flood control, hydraulic structures, and flood insurance studies. He is experienced with the numeric modeling of dams, rivers, pump stations, bridges; watershed hydrology and channel restoration using a wide variety of hydrologic and hydraulic computer models with GIS integration.

Mr. Gannon is a member of ASCE, and is a Diplomate of the American Academy of Water Resource Engineers, an American Institute of Hydrology registered Professional Hydrologist, and an Association of State Floodplain Managers Certified Floodplain Manager.

TOTAL YEARS OF EXPERIENCE

23

EDUCATION

2005-2007
MS, Civil
Norwich University

1995-1997
BS, Science
SUNY Institute of Technology, Utica, NY, United States

COURSES/CERTIFICATIONS

Project Management Professional, 2015-2022

PROFESSIONAL LICENSES

1/1/2019 - 12/31/2021
Certified Flood Plain Manager, United States

6/29/2015 - 6/29/2021
Professional Engineer, New York, United States
Civil - Water Resource

8/13/2013 - 12/30/2021
Professional Engineer, Ohio, United States
Civil - Water Resource

CONTACT INFORMATION

Shaun B Gannon

Shaun.Gannon@ramboll.com
+1 315-956-6961

Ramboll
101 First Street
4th Flr
Utica, NY 13501
United States of America

12/31/2005 - 9/29/2021
Professional Engineer, Pennsylvania, United States
Civil - Water Resource

1/14/2019 - 1/14/2022
Professional Hydrologist, United States

SPECIAL COMPETENCIES

River Gemorphology
Dam Safety
Hydrologic & Hydraulic Analysis and Modeling
Multi-Dimensional Fluid Modeling
Flood control and damage reduction
Watershed Management

PROJECTS

2019->>>
New York State Resilient NY Program
New York State Department of Environmental Conservation (NYSDEC) and Office of General Services (OGS), New York, United States
Technical Manager
Lead a team of engineers, planners and scientists working in cooperation with Federal, State, local municipalities, community organization, conservation groups and residence to identify causes of past flooding in select watershed through out New York State. Through a process of engagement, field observation, hydrologic and hydraulic analysis the team identifies root causes of open water and ice jam flood, evaluates mitigation alternatives, and works with stakeholders to identify priority projects to advance to design phase.

2019->>>
Thermal Impact Study for Kraft Heinz Facility
Kraft Heinz, New York, United States
Technical Manager
Directed the development of a a data collection plan, including bathymetry and thermal sensor deployment model in the West Branch of the Delaware River. Phase two includes the development of a three-dimensional thermal dispersion model of a submerged thermal plume discharge River. Calibration and model validation will be conducted against field collected data.

2016->>>
Sauquoit Creek Stream Bank Stabilization & Flood Mitigation, Whitestown, NY
Town of Whitestown, NY, New York, United States
Technical Manager
Lead the development of hydraulic modeling of conservation measures, such as flood plain benches, grade control structures, channel stabilization, using a two-dimensional model of the creek to determine critical velocity and shear stresses. A CFD model was developed to simulate the sediment transport and design of cross-vanes and flood-benches to minimize flooding and erosion. The parameters were then selected and be used in the project design of a stable channel that reconnects to the adjacent floodplain, reduces sediment transport, and lessens the flooding impacts to adjacent properties from higher frequency storms. Outcomes were used identify 13 potential projects. Two projects were selected for the first phase of construction which was completed in the fall of 2019.

2015->>>
Utica Taintor Gate Dam Rehabilitation
New York State Canal Corporation, New York, United States
Sr. Water Resource Engineer
Rehabilitation and modification of a combination fixed crest and taintor gated dam on the Mohawk River. Modeling included variations of gate numbers and sizes and fixed spillway length and elevation to achieve the desired headwater elevations of various frequency storms. Cofferdam Impact Studies, in-depth inspections, design of new steel gates and foundations were also provided.

2014->>>
Red House Lake Dam, Allegany State Park
New York State Parks, New York, United States
Technical Manager
Responsible for overseeing the review of the dam hazard classification including hydrologic and hydraulic analysis of the ½ PMF and 1% Annual Chance events. Additional analysis was done to support the geotechnical and structural evaluation of the dam.

2014->>>
Flood Warning and Operations System
New York State Canal Corporation, New York, United States
Technical Manager
Hydraulic Modeling for development of MIKE hydraulic models for select reaches of the Mohawk, Upper Hudson, and Oswego river basins. These included modeling of the Mohawk River, Indian River, Upper Hudson River, Seneca and Cayuga Lakes and their tributaries. The models were integrated into a custom interface allowing the Canal Corporation to better regulate flow within their system and to have advance warning of pending flood events allowing for improved operations.

2014->>>
Dam Safety Support – Indian Lake Dam
Hudson River Black River Regulatory District, New York, United States
Technical Manager
Oversaw the development of the hydrologic and hydraulic analysis of the Indian Lake Dam Engineering Assessment Report and Emergency Action Plan. Activities included field review and investigation, hydrologic development of the Probably Maximum Precipitation (PMP) hydrograph using HEC-HMS, hydraulic routing of "sunny day" and PMP events with and without breach using HEC-RAS, and outlet works capacity compliance in accordance with "NYS Guidelines for Design of Dam".

2011->>>
Repairs to Movable Dams, Multiple Locations
New York State Canal Corporation, New York, United States
Sr. Water Resource Engineer
Coordinated the developed HEC-RAS models to determine hydraulic loading for varying headwater and tailwater conditions at eight moveable dams on the NYS Canal system in support of structural evaluations for various gate loading / operating procedures.

2008->>>
Devils Lake City Embankments and Phase 1 Creel Bay Pump Station & Phase 2B East Ditch Pump Station Replacements
USACE, St. Paul District, North Dakota, United States
Sr. Water Resource Engineer
Responsible for performing modeling of the interior drainage for the Devil Lake, Embankment Raise project. The effort included developing a HEC-HMS model of the watershed, revising the stage-storage relationships using LiDAR based Digital Elevation Models (DEM) and unsteady HEC-RAS modeling of the storage and pumping system to determine proper pump station capacity for both the Creel Bay and East Ditch Pump Stations. Additional model was performed for the gatewell hydraulics and scour counter measures.

2008->>>
Devils Lake, North Dakota Embankment Raise and East Ditch Pump Station Replacement
USACE St. Paul District, North Dakota, United States
Sr. Water Resource Engineer
Conducted modeling for the interior drainage for the Devil Lake, East Ditch Embankment Raise project. The effort included developing an unsteady HEC-RAS model of the existing storage and pumping system to determine proper pump station capacity for the raised embankment condition to maintain existing flooding easements. Effort also included the design of channel modifications and a stilling basin; channel armoring, gatewell and replacement roadway culverts.

2008->>>
New York State Canal Corporation, Dam Safety Support – High Hazard Dams
New York State Canal Corporation, New York, United States
Technical Manager
Provided hydrologic and hydraulic analysis of five high hazard dams in the canal water supply system. Services included field review of each dam site and the potential downstream inundation zone; hazard class verification; verification of the outlet works capacity to pass the inflow design flood in compliance with NYS "Guidelines for Design of Dams", as well as incremental dam break analysis of masonry / earthen dams and routing using HEC-HMS and unsteady HEC-RAS models for the "sunny day" and "Spillway Design Flood". Results of hydraulic analysis will be used to recommend outlet works improvements / modifications while the breach modeling will be used to develop Emergency Action Plans and inundation mapping.

2020
Sauquoit Creek Post Storm Studies
Sauquoit Creek Basin Intermunicipal Commission, New York, United States
The Village of Whitesboro, NY was severely impacted by this flood including multiple residential properties suffering structural damage not previously experienced. Developed two reports, one detailing the reasons for damages experienced, and a second evaluating potential mitigation options ability to reduce future flood damages from a similar storm. These reports assisted the Village, Town, county and State in securing NRCS funding for property buyouts.

2019-2020
Lake Ontario Resiliency and Economic Development Initiative (REDI)
New York State Department of Environmental Conservation (NYSDEC) and Office of General Services (OGS), New York, United States
Subject Matter Expert - Flood Resiliency
Assisted in the execution of a comprehensive program to engage with stakeholders, identified assets at risk of Lake Ontario flooding, developed preliminary project designs. Over 13 weeks, this fast- paced project included implementing over 40 community stakeholder and planning committee meetings, screening over 570 assets at risk of flooding and associated projects, developing preliminary designs for 132 priority projects, creating 49 artistic renderings of select projects and providing overall program management and robust stakeholder engagement. As a part of this project Mr. Gannon also lead the engagement for Cayuga and Oswego Counties.

2019
Hydrodynamic and Sediment Transport Study of Existing Conditions and Restoration Alternatives at Rattlesnake Island
New England Interstate Water Pollution Control Commission (NEIWPCC) and New York State Department of Environmental Conservation(NYSDEC), New York, United States
Subject Matter Expert - Hydrodynamic Modeling
This project addressed the need to understand the impacts of dike modifications on the habitat and physical conditions of Coxsackie Cove and associated areas north and south of the project site. The project objectives were to conduct hydrodynamic and sediment transport modeling given three dike alternatives (existing, partial (50%), and complete removal) and two discharge scenarios (one-year storm, Hurricane Irene).
Directed the development of a one and a two-dimensional model of the Hudson River to simulate daily tidal and extreme event hydrologic conditions. The modeling will be used to determine the optimal means of reconnecting the Hudson River to the Rattlesnake Island backwater to improve water quality. Modeling also included unsteady 2D sediment transport modeling and analysis.

2018-2021
Conduit and Gate Repairs for the Binghamton Levee System
Dewberry, New York, United States
Ramboll assessed the condition of nine levee stormwater drainage structures in Broome County, New York. Ramboll performed site investigations in accordance with the NYSDEC and U.S. Army Corps of Engineers (USACE) procedures, provided recommendations for rehabilitating or replacing existing culverts and flap gates, prepared preliminary design of new gatewell structures and riverside sluice gates, and prepared construction cost estimates. The NYSDEC requested that Ramboll evaluate design parameters to install sluice gates in new riverside gatewells in the existing levee embankment.

2016-2020
A9.2 CSO Control Project
City Of Utica, NY, New York, United States
Ramboll performed design and construction phase services for a trunk storm sewer, located along the Oriskany Street/NYS Route 5S alignment from Washington Street to Broad Street in downtown Utica. The project consists of a large diameter east-west storm sewer designed to intercept existing storm sewers from the south, and convey them to Ballou Creek, and ultimately the Mohawk River to the east, reducing combined sewer overflows to the River and improving water quality within the impaired water body. The project will remove 17 million gallons in CSO volume to the river. The project also incorporates green infrastructure (GI) practices with funding provided by a grant under the Integrated Solutions Construction (ISC) Grant Program. These practices plan to achieve 79% of the water quality volume which more than triples the design minimum of 25% for the ISC Grant. These efforts continue the city's ongoing efforts to reduce stormwater runoff to the sewer system and to provide landscaping features within the city environment.

2016-2019
Environmental Assessment and Associated Studies for Proposed U.S. Courthouse
General Services Administration, New York, United States
Ramboll was selected by the U.S. General Services Administration (GSA) to prepare and Environmental Assessment (EA) and associated studies for a proposed U.S. Courthouse in Anniston, AL. The EA was to include three potential sites as well as a no action alternative.

2015-2018
3rd and 7th Ward Storm Sewer Outfall Repair Project
City Of Utica, Ny, New York, United States
Ramboll is supporting sewer separation projects for the City of Utica by diverting stormwater to reduce the overall volume of combined sewage discharged to surface water bodies. Among other requirements contained in the permit, the City is required to eliminate or capture for treatment or storage and subsequent treatment, at least 85 percent of the system wide combined sewage during wet weather events. Ramboll supported the repair of the 3rd and 7th Ward sewer outfall including the development of a two-dimensional HEC-RAS model of the Mohawk River to determine the magnitude and direction of river velocities and shear stresses at potential outfall locations. The results were used to select the final outfall location and to design the outfall's scour protective apron.

2013-2020
Utica Harbor Point Redevelopment
Elan Planning, New York, United States
Ramboll is supporting the development of Utica's Harbor Point into a niche destination attraction that leverages the natural appeal of the waterfront, the charm of an industrial-era harbor, the harbor's location along the historic Barge Canal, and the site's short distance from the New York State Thruway, Utica train station, and other regional tourist assets. Ramboll provided consulting services related to the environmental, permitting, and infrastructure needs of future mixed-use development at the Utica Harbor. The redevelopment of the harbor is part of an overall city, county, and state initiative to revitalize the Mohawk Valley Region, which includes development of the Marcy Nanocenter and the City's urban center. The revitalized harbor will attract visitors and help support the needs of a growing local workforce by offering housing and other quality of life benefits.

2001-2009
FEMA Map Modernization Program, Multiple NY Counties
New York State Office of General Services
Lead for the hydrologic and hydraulic modeling for development of Digital Flood Insurance Rate Maps (DFIRMS) for Cayuga, Onondaga, Herkimer, Schenectady, Green, Schoharie, Rockland, Jefferson and Ulster Counties. This work was performed in cooperation with New York State Department of Environmental Conservation, the Cooperative Technical Partner with the Federal Emergency Management Agency (FEMA). The results of these analyses will be transferred to GIS layers and used to produce Digital Flood Insurance Rate Maps and Flood Insurance Studies for the Counties.

TEACHING EXPERIENCE

2016-2020
Adjunct Professor of Hydrology, Department of Engineering, State University of New York Polytechnic Institute